

APPENDIX B –
City Traffic Signal Equipment Specifications

***** TRAFFIC SIGNAL SPECIFICATIONS FOR THE CITY OF SAN RAMON *****
June 9, 2009

SECTION ____ TRAFFIC SIGNALS.

____ - 1 GENERAL.

____ - 1.00 General.

The work covered by this section of these specifications consists of the installation of a complete traffic signal and safety lighting system at the intersection of _____ and _____

____ - 1.01 Specifications.

The provisions in the State of California, Department of Transportation, Standard Specifications (S. S.), Dated July 2006, SECTION - 86, "Signals and Lighting," and the State of California, Department of Transportation, Standard Plans (S.S.P.), Dated July 2006, shall apply except as modified, or enlarged upon, within these special provisions or the incorporated plans.

____ - 1.02 Business License and Permits.

The CONTRACTOR is responsible for obtaining a business license from the City of San Ramon - Building and Safety Services. The CONTRACTOR shall provide his/her Federal Employer ID Number, State Employer ID Number, Contractor's License Number, (a copy of pocket license issued by the State Contractor's License Board), and a Certificate of Insurance for Worker's Compensation with the City of San Ramon listed as a certificate holder.

The CONTRACTOR is also responsible for obtaining all necessary permits including a "No Fee" Building Permit for the electrical service installation from the City of San Ramon - Building and Safety Services and a "No Fee" Encroachment Permit from the City of San Ramon - Engineering Services. The CONTRACTOR shall be responsible for complying with all permit requirements including inspection.

____ - 1.03 Control of Work.

CONTRACTOR shall maintain vehicular, bicycle, and pedestrian access at all times.

____ - 1.04 Workmanship.

All facilities shall be installed in a professional and workmanlike manner. Any portion of the signal system that is not installed in a professional manner shall be removed and reinstalled correctly, to the satisfaction of the CITY INSPECTOR. All costs involved in complying with this section shall be considered included in the contract price and no additional compensation will be allowed therefore.

___ - 1.05 Submittals.

Submittals shall be in the form of manufacturer's cut sheets showing the brand name, specifications, model number, size, and any other information needed to identify the item to be used. If more than one type or size is shown on the cut sheet, the proposed item shall be highlighted or identified so that a determination can be made if the item meets the specifications.

The CONTRACTOR shall submit six (6) sets of submittals to the CITY INSPECTOR for review and approval on the following items:

- Signal Wire
- Loop Wire
- Detector Lead-in Cable
- Signal Interconnect Cable
- Loop Sealer
- Emergency Vehicle Preemption Equipment
 - a. Emitter
 - b. Detector
 - c. Phase Selector
 - d. Cable
- Service Pedestal
 - a. Specifications
 - b. Wiring Diagram
 - c. Circuit Breakers
 - d. Mercury Contactor
- Traffic Signal Controller
 - a. Cabinet
 - b. Input File
 - c. Output File
 - d. Power Distribution Assembly
 - e. Controller
 - f. PROM Module
 - g. Detector Amplifiers
 - h. DC Isolators
 - i. Flashers
 - j. Load Switches
 - k. Modem
 - l. Transfer Relays
 - m. Conflict Monitor
- Traffic Signal Poles
 - a. Pole Type
 - b. Tenon Location
- Traffic Signal Heads
 - a. Standard 12" Signal Head
 - b. Programmed Visibility Signal Head
- Mounts - Traffic Signal Heads
- Pedestrian Signal Heads
- Mounts - Pedestrian Signal Heads
- Pedestrian Push Buttons

- a. ADA Type Push Button
- b. Push Button Sign
- c. Push Button Base
- Internally Illuminated Street Name Signs
 - a. Sign
 - b. Legend
 - c. Mounting Brackets
- Electroliner
- Photo Electric Cell
- Prefabricated Loops
- Video Image Detection System
- Flashing Beacon
 - a. Single 12" Signal Head
 - b. 12" Yellow LED Signal Insert
 - c. Incandescent Sign Light
 - d. 365 Day Time Clock
 - e. Delay Timer
 - f. Duration Timer
 - g. Microwave Detector
 - h. 3R Enclosure
 - i. Circuit Diagram
- Extinguishable Message Sign
- Aggregate Base Mix Design
- Concrete Mix Design
- Asphalt Mix Design

___ 1.06 CERTIFICATE OF COMPLIANCE.

The CONTRACTOR shall submit to the CITY INSPECTOR, Certificates of compliance from the MANUFACTURER in accordance with the provisions of STATE SPECIFICATIONS SECTION 6-1.07, "Certificates of Compliance" for all items listed below at the time they are delivered to the job site.

- a. Signal Wire
- b. Loop Wire
- c. Detector Lead-in Cable
- d. Signal Interconnect Cable
- e. Loop Sealer
- f. Aggregate Base Mix
- g. Concrete Mix
- h. Asphalt Mix

___ 1.07 APPROVED EQUAL.

Requests for a determination that an item meets the "approved equal" provision of these specifications shall be submitted, in writing, to the CITY ENGINEER prior to ordering. The submittal shall include all technical specifications, catalog "cut sheets", a list of locations where the item has been used, and a sample of the item attached as an appendix.

___ **1.08 PURCHASE ORDERS.**

The CONTRACTOR may provide to the CITY, copies of all purchase orders for equipment and materials ordered for this project. The CONTRACTOR may also provide copies of any correspondence with suppliers concerning availability, delivery dates, anticipated delays and shipment notices within five days of each letter. References to cost may be omitted. Consideration for time extensions for equipment and materials delay may not be made unless this information is provided.

___ **1.09 EQUIPMENT DRAWINGS.**

The MANUFACTURER of the controller cabinet shall prepare a schematic wiring diagram of the cabinet and an intersection sketch combined into one drawing. The intersection sketch showing the vehicle detection loop numbers, their location in the intersection, and their connection point to the input file. It shall be drawn so that when the drawing is in the information envelope on the cabinet door, the drawing shall be properly oriented with the intersection. The CONTRACTOR shall supply to the CITY one (1) reproducible Mylar, one 1(1) electronic file, and four (4) reproduced hard copies of this drawing.

___ **1.10 OPERATION MANUALS.**

The CONTRACTOR shall furnish (2) maintenance and operation manuals for all equipment including the cabinet, controller unit, detector amplifiers, load switches, PROM modules, conflict monitors, emergency vehicle preemption equipment, video detection equipment, wireless communications devices, battery back-up units, and any other auxiliary equipment furnished. The operation manual and the maintenance manual may be combined into one manual. The individual or combined manuals shall be submitted at the time the control equipment is delivered to the CITY for testing or, if ordered by the CITY, prior to ordering equipment. The manuals shall include, but are not limited to, the following items:

- a. Specifications
- b. Design characteristics
- c. General operation theory
- d. Function of all controls
- e. Trouble shooting procedure (diagnostic routine)
- f. Block circuit diagram
- g. Geographical layout of components
- h. Schematic diagrams
- i. List of replaceable component parts with stock numbers

___ **1.11 WARRANTY AND GUARANTEE.**

The CONTRACTOR/MANUFACTURER shall guarantee the traffic signal and safety lighting system equipment, installed under these specifications, to the CITY for a period of not less than TWELVE (12) months following the date of acceptance thereof. If any part (or parts) is found to be defective in material, workmanship, or for any other reason within the warranty period and it is determined by the CITY and an authorized

manufacturer's representative that said part (or parts) cannot be repaired satisfactorily, the CONTRACTOR/MANUFACTURER shall provide a replacement part (or parts) of equal kind and/or type acceptable to the CITY. The twelve-month guarantee on the repaired or replaced parts shall again commence with the date of the reassembly of the system. All OPTICOM equipment shall be guaranteed in accordance with the manufacturer's warranty, which shall start on the day the traffic signal is put into full operation.

___ **1.12 SCHEDULING OF WORK.**

The first paragraph of STATE SPECIFICATIONS SECTION 86-1.06, "Scheduling of Work", is deleted.

___ **2.00 MATERIALS AND INSTALLATION.**

___ **2.01 FOUNDATIONS.**

Portland cement concrete for foundations shall conform to STATE SPECIFICATIONS SECTION 90-10, "Minor Concrete," and shall contain not less than 564 pounds of cement per cubic yard. Concrete for reinforced pile foundations shall also contain not less than 564 pounds of cement per cubic yard.

___ **2.02 STANDARDS, PEDESTALS AND STEEL POSTS.**

The CONTRACTOR shall be responsible for locating and marking the positions of all signal standards, pedestals, and steel posts. The CITY INSPECTOR shall review the locations before any work on the foundations is performed.

All signal standards shall be designed to withstand a wind velocity of 80 MPH.

All signal standards shall have a minimum of 2 inches and a maximum of 3 inches of grout installed between the bottom of the base plate and the finish grade.

All anchor bolts shall be galvanized over their entire length.

All steel guard posts shall be eight inches (8") in diameter and filled with concrete. The guard posts shall be located as shown on the plans. The guard posts shall be painted in accordance with Section ___ - 2.10, "Painting."

___ **2.03 CONDUIT.**

Conduit which is installed underground shall be rigid, nonmetallic type as defined in STATE SPECIFICATIONS SECTION 86-2.05A, "Material". All conduits shall enter a pull box with a 45-degree sweep unless permitted otherwise by the CITY INSPECTOR. A 3/8-inch pull rope shall be installed into every conduit run. All conduits in a foundation and between a foundation and the nearest pull box shall be rigid, nonmetallic type conduit.

The minimum diameter for all new conduit installations shall be 3 inches. Unless otherwise indicated on the plans, all modifications and extensions to existing conduit

runs shall be made with conduit constructed of the same material. If a different conduit material is used, a pull box shall be installed at the location of the material change.

The first paragraph in STATE SPECIFICATIONS SECTION 86-2.05B, "Use," is amended to read:

"Conduit to be installed on the surface of poles or structures or other exposed locations shall be the rigid metal or "Intermediate Metallic Conduit" type."

The fourth sentence in the third paragraph in STATE SPECIFICATIONS SECTION 86-2.05C, "Installation," is amended to read:

"When a standard coupling cannot be used for coupling metal type conduit, a UL listed threaded union coupling, concrete tight split coupling or concrete tight set screw coupling shall be used.

After conductors have been installed, the ends of conduits terminating in pull boxes and controller cabinets shall be sealed with a sealing compound approved by the CITY.

Insulated bonding bushings will be required on metal conduit.

___ 2.03A TRENCHING.

The CONTRACTOR shall notify

**"UNDERGROUND SERVICE ALERT" (USA)
1-800-227-2600**

two (2) working days prior to any excavation.

Where conduit is to be installed under pavement, and existing underground facilities requiring special precautions, the conduit shall be placed by the trenching method, unless noted otherwise on the plans.

At locations where conduit is to be installed by jacking or drilling as provided in STATE SPECIFICATIONS SECTION 86-2.05C, "Installation," and if there will not be any delay to any vehicle traffic, the conduit may be installed by the trenching method if approved by the CITY.

The CONTRACTOR shall be responsible for installing all new conduits shown on the drawings. Conduit runs shown on the plans to be located behind the curb or sidewalk may be installed in the street next to the lip of the gutter if approved by the CITY.

Conduit installed by trenching within the street section shall be performed as follows:

1. Conduit shall be placed under existing pavement in a trench approximately 2 inches wider than the outside diameter of the conduit to be installed. Trench width shall not exceed 6 inches. The top of the installed conduit shall be a minimum of 12 inches below finish grade.

2. The outline of all areas of pavement to be removed shall be cut to a minimum depth of 2 inches with an abrasive type saw or with a rock cutting excavator specifically designed for this purpose. Cuts shall be neat and true and there shall not be any shattered pavement outside of the area where pavement is removed.
3. Conduit shall be placed in the bottom of the trench and the trench shall be filled to not less than 2 inches below the surface of the pavement with commercial quality concrete containing not less than 564 pounds of cement per cubic yard. The top 2 inches of trenches in roads surfaced with asphalt concrete shall be backfilled with asphalt concrete produced from commercial quality paving asphalt and aggregate.
4. Spreading and compacting of asphalt concrete shall be performed by any method, which will produce an asphalt concrete surfacing of uniform smoothness, texture, and density.
5. During trenching operations, the CONTRACTOR shall provide a minimum of ONE (1) 12-foot wide traffic lane in each direction. The CONTRACTOR shall also provide for the safe passage of bicyclists and pedestrians through the construction site.
6. Trenching operations shall be performed in such a manner that all trenching and backfilling will be completed by 3 P.M. each day. The CONTRACTOR shall provide for the free and unobstructed flow of vehicle, bicycle, and pedestrian traffic in the project area by 3 P.M. each workday.
7. All vehicle, pedestrian, and bicycle lanes shall be open to traffic at the completion of the trenching operation.
8. In lieu of the provisions in STATE SPECIFICATIONS SECTION 12-2.02, "Flagging Costs," the entire cost of all flagging and traffic control required during the trenching operations shall be borne by the CONTRACTOR, and no additional compensation will be allowed therefore.

___ 2.04 PULL BOXES.

The CONTRACTOR shall be responsible for locating and marking the positions of all pull boxes. The CITY INSPECTOR shall review the locations before any installation work is performed.

All new pull boxes shall be "PCC Type", unless noted otherwise on the plans or approved by the CITY. The sumps of all new pull boxes installed shall not be grouted. Pull box sumps shall be constructed from 1" minimum diameter clean/washed river run rock to a minimum depth of 12". Recesses for suspension of ballast will not be required. Where the sump of an existing pull box is disturbed by the CONTRACTOR's operations, the sump shall be removed and a new rock sump installed.

All pull boxes shall be raised to grade and leveled prior to the installation of any conductors or pull ropes.

All traffic signal pull box lids shall be imprinted "Traffic Signal" and all interconnect pull box lids shall be imprinted "Interconnect". Reinforced plastic or fiberglass lids for No. 6 pull boxes are permitted, all others shall be concrete. All 20" x 42" pull boxes shall be furnished with split lids.

___ 2.05 CONDUCTORS.

The CONTRACTOR may install multi-circuit signal cable in lieu of individual conductors if approved by the CITY ENGINEER. Multiple circuit conductors shall conform to the provisions in STATE SPECIFICATIONS SECTION 86-2.08B, "Multiple Circuit Conductors".

All control circuit conductors shall be run continuously without splices from a terminal block located in a cabinet, compartment, or signal head, to a similar located terminal block.

___ 2.05A INTERCONNECT CABLE.

The interconnect Cable shall conform to REA-PE-39 Specifications and the following:

The cable shall consist of twenty-four (24) No. 19 AWG (12 twisted pairs) solid copper conductors with each conductor insulated with a high molecular weight, heat stabilized, color-coded, polyethylene material. The conductors shall be in twisted pairs. The core shall be protected by a polyester film with a single longitudinally applied corrugated shield of 5 mil copper or 8-mil aluminum. The cable shall be provided with an outer jacket consisting of an extruded black low density, high molecular weight, heat stabilized polyethylene material a minimum of 0.06-inch thick, which shall be resistant to sunlight and chemicals. The entire cable within the outer jacket shall be flooded with a petrolatum polyethylene gel-filling compound to eliminate possible moisture content, migration, or ingress. If the existing interconnect is to be cut and connected, the contractor shall notify the engineer 24 hours in advance. No more than 48 hours shall pass with the interconnect cable severed.

___ 2.06 WIRING.

At least 6 feet of slack shall be provided in the pull box nearest each signal standard, for those signal conductors terminating in that standard, and 3 feet of slack shall be provided in each signal conductor in all other pull boxes. The wire bundle entering the controller cabinet shall be coiled in the bottom of the cabinet in order to obtain as much slack as possible. A 3/8-inch pull rope shall be installed in all conduits.

Straight splices in signal neutral and multiple lighting conductors shall be insulated in conformance with Method B, tap splices in signal neutral and multiple lighting conductors shall be Type C, and conductors shall be spliced by the use of C-shaped

compression connectors, all as shown on S.S.P. ES-13. Alternate methods of splicing shall be approved by the CITY ENGINEER in writing prior to use in the field.

Identification bands shall be constructed from a nylon cable tie with a 3/8 inch by 3/4 inch label flag attached (T & B TyRap Cable Ties, #TY 553 or approved equal). The marking pen shall be one recommended by the manufacturer of the cable tie and shall be an indelible marking pen capable of writing on the nylon material (TyRap Marking Pen, # WT 163 M-1, Black or approved equal). No other method of labeling will be acceptable. All conductors shall be labeled in the pull box nearest their termination, and in the controller cabinet. All signal conductors shall be labeled by phase designations. All detector lead-in cables shall be labeled by phase designation and loop number. All loop conductors shall be labeled by loop number and location in the street. Lighting conductors (street or sign) shall be labeled as appropriate. Spare conductors shall be labeled with blank labels.

Conductors shall not be pulled into the conduits until the pull boxes have been set to grade and the crushed rock sumps installed. All pull boxes shall be inspected by the CITY INSPECTOR before pulling any conductors. Conductors shall not be pulled into conduits unless the CITY INSPECTOR is present to observe the operation. Conductors and pull rope shall NOT be taped or tied together. Each conductor and pull rope shall be free moving within the conduit. The ends of all cables shall be sealed prior to installation in conduits. After conductors have been installed, the CONTRACTOR shall test all conductors and cables in accordance with STATE SPECIFICATIONS SECTION 86-2.14 "Testing" in the presents of the CITY INSPECTOR. The insulation resistance shall not be less than 1,500 megohms on all circuits including loop detector circuits. Conductors or cables shall not be terminated or sealed until they have passed all tests specified herein. The ends of all unused cables shall be sealed.

___ 2.06A INTERCONNECT.

All interconnect cable shall be installed in one continuous piece, without splices, between controller cabinets, unless noted otherwise on the plans. Each cable shall be labeled as to destination and direction in each pull box and controller cabinet.

The CONTRACTOR shall terminate the interconnect cable on a terminal block in each controller cabinet as directed by the CITY INSPECTOR.

Testing of the interconnect cable shall be done on each individual wire to insure continuity. Insulation resistance value shall not be less than 1,500 megohms. Testing will be done by the CONTRACTOR in the presence and to the satisfaction of the CITY INSPECTOR.

___ 2.07 BONDING AND GROUNDING.

Grounding jumpers shall be visible after the concrete cap has been placed on all foundations and shall be attached to the standard and the system ground. The system ground shall be #8 copper. Equipment grounding conductors will not be required in conduits containing only interconnect cables.

Anchor bolts for Type 1-B standards shall be bonded together and to the metallic conduit or to the bonding conductor in a non-metallic conduit. 3/16 inch or larger bolts will not be required for the Type 1-B standards. Anchor bolt bonding shall be inspected and approved by the CITY INSPECTOR prior to the placing of foundation concrete.

2.08 SERVICE.

Energy for the traffic signals and the internally illuminated street name signs shall be metered. Energy for the safety lighting shall not be metered.

The CONTRACTOR shall furnish and install the Type III-AF Service Cabinet for switchgear as shown on the signal plans and as provided in STATE SPECIFICATIONS SECTION 86-2.11 "Service", and these Special Provisions. The service cabinet shall conform to the following:

1. Items 1 thru 8, 15 thru 17, and 20 thru 25 shall be furnished as shown of S.S.P. sheet ES-2d.
2. Circuit Breaker # 16 shall be changed to a 20A., 240V., 2P. circuit breaker.
3. The service cabinet wiring diagram shall be submitted to the CITY for approval prior to fabrication of the cabinet.
4. The cabinet shall be constructed from 0.125 inch minimum thickness anodized aluminum with all exterior seams welded.
5. Exterior dimensions of the cabinet shall not exceed:
 - 65 inches high
 - 13 inches wide
 - 9 inches deep
6. All hinges shall be continuous aluminum piano type with stainless steel pins.
7. All interior bussing shall be copper.
8. The meter enclosure shall be provided with a factory installed bypass facilities as required by Pacific Gas & Electric.
9. The serving utility termination shall be in the meter area.
10. The service neutral shall be terminated in the customer area of the cabinet.
11. Circuit breakers shall be furnished as shown on the plans and installed in a vertical position.
12. The PEC circuit shall operate two (2) mercury contactors for luminaries (240 volt) and IISNS (120 volt) and the termination points shall be capable of holding up to four (4) conductors.
13. All interior labels shall be made of routed phenolic material and fastened with stainless steel (or other compatible material) screws.
14. All cabinet wiring shall be labeled with permanent clip sleeve wire markers. Felt, pencil, or stick on markers are not acceptable.
15. The cabinet shall be equipped with a 1/4 inch thick Lexan sealed window so that the service meter can be read without opening the service cabinet.

City shall pay all required utility fees and costs related to providing electric service connections and telephone service connections (if required) at the site of the work. The CONTRACTOR shall pay all utility bills until the traffic signal is accepted by the City. At this time, the service billing shall be transferred to the City.

In lieu of the provisions in the last paragraph in STATE SPECIFICATIONS SECTION 86 - 2.11, "Service," labor and materials costs for the entire service conduit connection from the service cabinet or controller cabinet to the service location of the serving utility company (PACIFIC GAS & ELECTRIC and/or PACIFIC BELL) shall be considered as included in the contract price paid for signals and lighting and no additional compensation will be allowed therefor.

___ **2.08 UNINTERRUPTED POWER SUPPLY.**

Contractor shall provide an "Uninterrupted Power Supply (UPS)" for each signal location, which shall provide a minimum of 2 hours of "full" operation run time for each traffic signal. Manufacturer shall verify the number of LED signal heads at each intersection, and provide the number of batteries necessary for the 2-hour operation at each site. A minimum of three (3) batteries shall be provided. The UPS shall be bolted to the back of the service cabinet in a manner recommended by the manufacturer, and shall be mounted to the Type III-AF service cabinet at the factory by the manufacturer of the service cabinet. The UPS shall be a TESCO Controls Model No. 1400XL, or approved equal, and shall conform to the following:

___ **2.08A UPS ENCLOSURE.**

A non-reflective anodized aluminum weatherproof enclosure shall house UPS and batteries in accordance with STATE SPECIFICATIONS SECTION 86-2.11. Enclosure shall have fully-framed side hinged outer doors with swaged close tolerance sides for flush fit with drip lip and closed cell neoprene flange compressed gaskets. Front door shall incorporate a full-length stainless steel piano hinge, pad-lockable draw latch (center area on door- latch side, no hasps), and shall provide a Best Lock key lock. There shall be no exposed nuts, bolts, screws, rivets or other fasteners on the exterior of the enclosure. UPS shall be mounted in an interior tilt out housing with 800lb rated stops. Battery connectors shall be Anderson Connectors with silver plated contacts. Batteries shall be installed in fixed position framed trays for seismic safety and be readily accessible for maintenance. Batteries shall be mounted allowing airflow front and back. Enclosure shall include two transfer bypass switches, one for UPS bypass the second for auxiliary generator. All switches must be panel mounted on interior dead front panel board. UV resistant plastic laminated nameplates shall identify all controls and major components. A plastic covered wiring diagram will be attached to the inside of the front door. All components shall be factory wired and conform to required NEMA, NEC and UL standards. A chassis ground point shall be provided. Panel shall be UL 508 Industrial Control Panel rated.

___ **2.08B UPS PANEL.**

The uninterrupted power supply shall include the following minimum features:

1. Generator transfer switch with UPS bypass and lockable, metallic, 30 amp external reverse service plug.
2. UPS bypass and UPS isolation switch.
3. Dead front safety panel board with all switches, indicating fuses, plugs, and isolation fuses for each battery pre-wired with phenolic nameplates.
4. All nameplates shall be screwed on phenolic engraved type.
5. All wire terminating lugs shall be full wrap-around type.
6. All batteries shall be captive-spaced from external cabinet sides in earthquake proof buckets. Cabinet ventilation shall be by (qty. 4) 4" x 1/4" louvers top and bottom with encapsulated bug screens, cleanable filters and a 100 CFM fan to completely exchange air 25 times per minute.
7. All DC terminals and connections shall incorporate safety covers such that the safety covers are in place for every normal maintenance mode.

___ 2.08C POWER SUPPLY UNIT.

UPS unit shall provide a true sine-wave output with minimum 1400 Volt-Amp continuous capacity. UPS must provide for utility service isolation when in operation. The minimum rating for wattage output will be 950 watts. The UPS shall be capable of running an intersection with all LED lights for 120 minutes. The unit shall operate off-line, with transfer time of 2 ms or less, with battery condition indicator, with automatic test provisions, and with hot-swappable batteries (all batteries in system). UPS will automatically recharge batteries from full discharge to 95% capacity within 6 hours. UPS will provide on-line operation for a minimum input range of 92 to 145V AC, provide full load output of 120V AC - 10% / +4% at 60 Hz +/- 0.05% over a temperature range of -35°F (-37° C) to +165°F (74° C) and be a UL Approved Design. The UPS unit will be delivered with maintenance manuals and schematic diagrams.

UPS Unit Minimum Features:

1. 1400VA 950 W
2. Surge energy to withstand 480 Joules, 6.5kA
3. Common mode clamping 0 ns < 5 ns typical UL 1449
4. Conditioned power -Computer quality
5. Transient lighting protection -160 Joules
6. Transfer to battery time -2 ms
7. Retransfer to utility -2 ms
8. Each battery shall be 24 volts @ 18 AH with heavy duty Anderson plugs and isolated fused (dead front panel mounted 30 amp) connections to the UPS for greater system reliability and maintainability. Series wiring is unacceptable.
9. Fan cooling shall be fused for locked rotor current.
10. Cooling air shall be ducted to cool the front and back of each battery with air space on all four sides and top of each battery.
11. UPS covers shall be 60% open on both sides to diminish the environmental reaction to extreme temperatures.

12. Includes a DB9 Computer Interface Port.
13. Low voltage safety design at 24V DC. (Higher voltage DC systems are unacceptable).

UPS Communications Module:

- Smart Slot Relay I/O Module;
- Input #1 Turn the UPS on.
- Input #2 Turn the UPS off.
- Input #3 Start the UPS self-test.
- Input #4 Shut down the UPS (when on battery).

- Output #1 The UPS is on-battery (during a power failure, self test or run time calibration).
- Output #2 UPS has a low battery -Programmable.
- Output #3 The protected load is not receiving power from the UPS.
- Output #4 Replace the UPS batteries.
- Output #5 The UPS is overloaded.
- Output #6 Any UPS fault or self-test failure.

Batteries: Batteries shall be maintenance-free, type AGM/VRLA (Absorbed Glass Mat/ Valve Regulated Lead Acid), such as APC Smart-UPS RMXL or approved equal. Batteries shall be independently pre-wired and individually fused. Batteries shall be furnished with heavy-duty 50 amp silver-plated Anderson Connectors to each battery individually. Batteries shall not exceed 26 lbs in weight. (Series or parallel wiring will not be acceptable) /

Enclosure temperature compensation: operating temperature shall be a minimum - 35°F (-37° C) to +165°F (74° C)

Power System Analyzer and Conflict Resolution Module: The UPS shall incorporate an integrated Power System Analyzer and Conflict Resolution Module. The Analyzer will evaluate and make limited adjustments to the incoming utility power and will automatically transfer load to the UPS battery back-up power if utility power is lost. When utility power becomes available, the system will automatically return to normal operation.

The Conflict Resolution Module will provide automatic UPS failure detection and automatically isolate the failed UPS and transfer the load back to utility power. Once the failure has been corrected, the system will return to normal operation. This system shall include the following as a minimum:

Triple Bypass System for offline UPS:

1. SPACT -Smart Power Analyzer with Conflict Monitor Isolation and Transfer Module.
2. PCM – Power Conflict Monitor
3. The outboard Smart Transfer Switch shall not interrupt the normal controller function. Transfer time shall be 2ms.

4. Onboard Smart I/O module will execute lockout of battery backup system upon Smart detection of any inverter UPS fault. If UPS resets itself, it will automatically be available for backup.

Power Conflict Monitor (PCM)

The PCM shall be a totally redundant failsafe system. The PCM monitors load bus power available continuously. If load bus power fails for 50ms the PCM will transfer and isolate the UPS and guarantee that commercial power will be locked on.

Smart Battery Charger: Shall charge from shut off discharge to 95% fully charged in less than 6hrs. Batteries shall be ambient enclosure compensated to less than 120°. The battery charger shall utilize Smart Cell Technology to extend battery life.

Intelligent Battery Management:

Cell Guard -Improved reliability results from a precision battery charging system, and automatic true-load battery tests. Redundant overcharge protection contributes to longer battery life. SmartBoost and SmartTrim regulate under and over voltages without switching to battery.

Battery Replacement Warning- The UPS shall automatically perform a self-test every two weeks. Through software, or the push of a button, self-tests may be performed at anytime.

Fast Recharge Time -The UPS battery charging system shall be microprocessor controlled to precisely charge batteries in less time than legacy UPS systems, to make the system available more quickly for subsequent power disturbance.

Battery Replacement Features- The unit shall be capable of allowing safe and easy replacement of batteries while the system is operating.

Warranty- Manufacturer shall provide full replacement for two (2) years. The warranty shall be included in the total bid price, and shall begin on the day the unit is turned on. Manufacturers shall provide a two-(2) year factory-repair warranty for parts and labor on the UPS.

___ 2.09 TESTING.

___ 2.09A MATERIAL TESTING.

Within fourteen (14) calendar days of receipt of CONTRACTOR's submittals, the CITY shall have the right to request a sample of any materials used for the construction of the traffic signal or the interconnect system. Including, but not limited to, controller cabinet, signal heads, poles, conductor wire, or interconnect cable, and any other item deemed necessary to be tested or inspected for compliance to the specifications. The CONTRACTOR shall deliver those materials requested within twenty-one (21) calendar days of request. If the CITY does not receive the requested materials within the time specified, those materials requested shall be deemed to be unsatisfactory, and rejected.

The MANUFACTURER of the controller system, specified in Section ____ - 3.03, "Model 170 Controller Assembly", shall certify to the CITY that the "assembly" has been thoroughly bench and operationally tested, and that as a controller assembly, all components are operating in conformance with these Specifications.

The controller cabinet, controllers, and all auxiliary equipment shall be delivered, F.O.B., to a controller testing facility as directed by the CITY for a 21 day full operational test.

The testing facility is currently located at:

CITY OF SAN RAMON
SERVICE CENTER
5000 Crow Canyon Road
San Ramon, CA. 94583
(925) 973-2800

All shipping cartons and cabinets shall be externally labeled with the site location.

If unsatisfactory performance of the equipment develops, the equipment shall be replaced or repaired by the MANUFACTURER and the test shall be repeated until the 21 days of continuous, satisfactory operation is obtained.

If any of the material or equipment is rejected for failure to comply with the requirements of these specifications, the CONTRACTOR shall be responsible for replacing all rejected equipment or materials. The CONTRACTOR shall pay all of the costs involved in re-testing the replacement equipment or materials.

If the CONTRACTOR fails to replace and/or retest any rejected equipment or materials, the CITY may replace and/or retest any rejected equipment or materials and deduct all cost of such replacement and/or re-testing from any moneys due or which may become due the CONTRACTOR under the provisions of the Agreement (Contract or Purchase Order).

All costs involved in complying with this section shall be considered included in the contract price paid for the traffic signals and safety lighting and no additional compensation will be allowed therefore.

___ **2.09B INSPECTION AND TURN ON.**

Upon the completion of the traffic signal installation, the CONTRACTOR shall request a final inspection from the CITY. Upon completion of the inspection and correction of all deficiencies found, the CONTRACTOR shall request an activation date from the CITY. The CONTRACTOR shall arrange to have a signal technician, employed by the controller manufacturer or his representative and qualified to work on the controller, present at the project site at the time the equipment is activated.

___ **2.09B INSPECTION.**

Upon the completion of the traffic signal modifications, the CONTRACTOR shall request a final inspection from the CITY. Upon completion of the inspection and correction of all deficiencies found, the CONTRACTOR shall notify the City in writing that all work has been completed and request the start of the functional test period.

___ **2.09C FUNCTIONAL TESTING.**

A functional test of the traffic signal system shall be performed in the field, and shall consist of not less than fourteen (14) continuous days of operation. If unsatisfactory performance of the system develops, the conditions shall be reported to the CONTRACTOR and the CONTRACTOR shall have 72 hours to initiate the necessary repairs and shall vigorously pursue the repairs until they are complete. When the CONTRACTOR notifies the CITY that the repairs are complete, the test shall be repeated until the fourteen (14) days of continuous, satisfactory operation are obtained. The Contractor shall be responsible for all of the costs involved in the repair of the equipment, including re-testing if necessary.

After successful completion of the fourteen (14) day test, the CITY may relieve the CONTRACTOR of maintenance for the signal. Maintenance by the CITY will not relieve the CONTRACTOR from repairing any deficiencies found prior to the acceptance of the traffic signal by the CITY.

The CONTRACTOR at his expense shall repair any damage to the new facilities prior to final acceptance by the CITY.

___ **2.10 PAINTING.**

Signal standards and guard posts shall be spray painted over the entire surface with 2 coats of "Williamsburg-Blair House Green", Sherwin-Williams (Martin-Senour), High Gloss Polane HS Enamel (H.S. No. F63HXG12408127), or approved equal. Only EXTERIOR CATALYST V66V29, shall be used with the Polane HS Enamel paint.

All questions about the paint availability, specifications, preparation, or application should be directed to:

Sherwin Williams - Dublin Branch
(925) 551 - 8355

___ **2.10A STANDARD PAINTING.**

All signal standards shall be painted after erection and prior to installing any signal heads, or framework.

Steps for painting poles shall be:

- a. Clean all surfaces to be painted with a high-pressure acetone wash.
- b. Prime all surfaces with Sherwin Williams P60-G2, Industrial wash primer.
- c. Apply first coat of finish color - slight shade lighter than specified color.
- d. Apply second coat of finish color - specified shade.

___ **2.10B TRAFFIC SIGNAL HEAD PAINTING.**

All traffic signal heads, visors, and frameworks shall be "factory powder coat" painted in lieu of conventional painting. The CONTRACTOR shall take extreme care not to damage the surface. Any scar marks or cosmetic damage to the equipment caused from tools or installation processes shall be cause for rejection.

The factory powder coat finish shall be applied as described below:

1. Pretreatment Process:
 - a. Acid etch degreasing bath
 - b. Clean water rinse
 - c. Iron phosphate adhesion bath
 - d. Clean water rinse
 - e. Non-chromate acidulated seal bath
2. Thermal Set Process:
 - a. Convey parts through drying oven for 10 minutes at 300/400 deg./F.
 - b. Apply polyester or epoxy-based dry powder coating at 75-90 KV.
 - c. Convey parts through curing oven for thermal setting for 20 minutes at 400 deg./F.

___ **3.00 CONTROLLER ASSEMBLIES.**

___ **3.01 CONTROLLER ASSEMBLY.**

The Controller System and components shall conform to the State of California Business, Transportation and Housing Agency, Department of Transportation, "Traffic Signal Control Equipment Specifications," dated January 1989, including all other current addenda.

Upon request of the CITY, the MANUFACTURER shall provide proof of compliance with the "Traffic Signal Control Equipment Specifications" for the various components making up the controller system. This proof may be in the form of inclusion on the State of California, "Qualified products List" (QPL).

All components furnished shall form a complete functional controller system capable of providing the traffic signal operation specified, and capable of operating as part of a coordinated system, either under the control of a "Master Controller" system or on "Time Base" coordination.

___ 3.02 LOCAL CONTROLLER CABINET.

- . The local controller cabinet shall be a type 332 and constructed from anodized aluminum. The cabinet shall be a rainproof cabinet with front and back doors with dimensions as shown on the plans. The cabinet top shall be crowned ½ inch (13 mm) or slanted to the rear to prevent standing water.
- . The cabinet and doors shall be fabricated 0.073-inch (3 mm) minimum thickness anodized aluminum. All exterior seams shall be continuously welded. Exterior welds shall be ground smooth. Edges shall be filed to a radius of 0.03125 inches (0.8 mm), minimum.

. Cabinets fabricated from aluminum sheet shall conform to the requirements in ASTM Designation: B 209 or B 209M for 5052-H32 aluminum sheet.

1. Welding on aluminum cabinets shall be done by the gas metal arc welding (GMAW) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements in American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.
2. Procedures, welders and welding operators for welding on aluminum shall be qualified in conformance with the requirements in AWS B3.0, "Welding Procedure and Performance Qualification," and to the practices recommended in AWS C5.6.
3. The surfaces of each aluminum cabinet shall be finished to conform to the requirements in Military Specification MIL-A-8625C "Anodic Coatings for Aluminum and Aluminum Alloys" for a Type II, Class I coating, except that the anodic coating shall have a minimum thickness of 0.0007 inches (0.02-mm) and a minimum coating weight of 27 mg/in² (0.04-mg/mm²). The anodic coating shall be sealed in a 5 percent aqueous solution of nickel acetate (pH 5.0 to 6.5) for 15 minutes at 210°F (97°C). Prior to applying the anodic coating, the cabinets shall be cleaned and etched as follows:
 - a. Clean by immersion in inhibited alkaline cleaner such as Oakite 61A or Diversey 909, or equivalent, 45-60 g/L, 160°F (71°C) for 5 minutes.
 - b. Rinse in cold water.
 - c. Etch in a solution of 11g of sodium fluoride, plus 30-45g of sodium hydroxide per liter of distilled water at 140°-149°F (60°-65°C) for 5 minutes.
 - d. Rinse in cold water.

- e. Desmut in a 50 percent by volume nitric acid solution at room temperature for 2 minutes.
 - f. Rinse in cold water.
- . The cabinet shall have a front and rear doors equipped with locks. The door widths shall not exceed 44 inches (1120 mm). When the doors are closed and latched, the doors shall be locked. The handles shall have provision for padlocking in the closed position. The handles shall have a minimum length of 7 inches (175 mm) and shall be provided with 5/8-inch (15-mm) minimum, steel shanks. The handles shall be fabricated of cast aluminum or of zinc-plated or cadmium-plated steel. The cabinet door frames shall be designed so that the latching mechanisms will hold tension on and form a firm seal between door gasketing and door frames. Cabinet locks shall be the solid brass, 6-pin tumbler rim type. The locks shall have rectangular, spring-loaded bolts. The locks shall be left hand, and rigidly mounted with stainless steel machine screws approximately 2 inches (50 mm) apart. Keys shall be removable in the locked and unlocked positions, and 2 keys furnished with each cabinet. The front position of the lock shall extend 1/8 to 3/8 inches (3-9 mm) beyond the outside surface of the door.
 - . The latching mechanisms shall be 3-point cabinet latches with nylon rollers. The center catches and pushrods shall be zinc-plated or cadmium-plated steel. Pushrods shall be turned edgewise at the outer supports and shall be 1/4 inch (6 mm) x 3/4 inch (20 mm), minimum. The nylon rollers shall have a minimum diameter of 3/4 inch (20 mm) and shall be equipped with ball bearings.
 - . All cadmium plating shall conform to the requirements in Military Specification MIL-QQ-416b. All zinc plating shall conform to the requirements in Military Specification MIL-QQ-325b.
 - . The doors' hinging shall be three-bolt butt hinges. Each hinge shall have a fixed pin. Doors larger than 22 inches (560 mm) in width or 6 square feet (0.56-m²) in area shall be provided with catches to hold the door open at both 90 degrees and 180 degrees, plus or minus 10 degrees. The catches shall be 3/8 inches (9-mm) diameter, minimum, plated steel rods. The catches shall be capable of holding the door open at 90 degrees in a 60 mph (90 km/h) wind at an angle perpendicular to the plane of the door.
 - . The police panel shall be mounted on the door as shown on the plans, and equipped with a lock keyed for a master police key. Two keys shall be furnished with each cabinet for the police lock. Each police key shall have a shaft at least 1-3/4 inches (45 mm) in length. Police panels shall not be furnished for controller assemblies that do not control traffic signals.
 - . Door hinges, pins and bolts shall be made of aluminum with a stainless steel hinge pin. The hinges shall be bolted to the cabinet. The hinge pins and bolts shall not be accessible when the door is closed.
 - . Gasketing shall be provided on all door openings and shall be dust-tight. Gaskets shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating surface.
 - . Details of alternative designs shall be submitted for review and approval prior to the fabrication of the cabinets.
 - . Substantial metal shelves or brackets shall be provided to support controller unit and auxiliary equipment.
 - . Machine screws and bolts shall not protrude beyond the outside wall of the cabinet.
 - . Conduit shall enter the controller cabinet at the front unless shown otherwise on the plans.

- A pliable seal, composed of caulking compound or mastic, shall be placed between each controller cabinet and the concrete foundation to prevent water, dust and dirt from entering the cabinet.

3.02A Cabinet Ventilation

- Each controller cabinet shall be provided with 8 screened, raintight vent holes, ½ inch (12 mm) in diameter or larger, in the lower side or bottom of the cabinet, or at the option of the Contractor, louvered vents with a permanent metal mesh or 4-ply woven polypropylene air filter held firmly in place, which will permit the fan to pass the volume of air specified, may be substituted.
- Each controller cabinet shall be equipped with an electric fan with ball or roller bearings and a capacity of at least 100 cubic feet per minute (2.83 m³/min).
- The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 90°F (32°C) and 149°F (65°C) with a differential of not more than 6°C between automatic turn on and turn off. The cabinet fan circuit shall be fused at 125 percent of the ampacity of the fan motor installed.
- The fan and cabinet vent holes shall be located with respect to each other so as to direct the bulk of the air flow over the controller unit or through the ventilating holes of the controller unit where those holes exist.

-3.02B Cabinet Wiring

- Conductors used in controller cabinet wiring shall be No. 22, or larger, with a minimum of 19 strands. Conductors shall conform to Military Specification MIL-W-16878D, Type B or better. The insulation shall have a minimum thickness of 10 mils (0.25-mm) and shall be nylon jacketed polyvinyl chloride or shall be irradiated cross-link polyvinyl chloride, polyhalocarbon or polychloro-alkene, except that, at the Contractor's option, conductors No. 14 and larger may be UL Type THHN.
- At the Contractor's option, flat cable may be used in lieu of individual conductors. Cable shall be constructed of No. 28, or larger, conductors. Conductor insulation shall be rated at 300 V and shall be rated for use at 221°F (105°C). Cables shall be provided with strain relief.
- Wiring within controller cabinets shall be neatly arranged and laced, or enclosed in plastic tubing or raceway.
- Conductors used in controller cabinet wiring shall conform to the following color-code requirements:
 1. The grounded conductor of a circuit shall be identified by a continuous white or natural gray color.
 2. The equipment grounding conductor shall be identified by a continuous green color or by a continuous green color with one or more yellow stripes.
 3. The ungrounded conductors shall be identified by any color not specified in 1 or 2 above.
- Conductors used in cabinet wiring shall terminate with properly sized captive or spring spade type terminals or shall be soldered to a through-panel solder lug on the rear side of the terminal block. Crimp-style connectors shall be applied with a proper tool which prevents opening of the handles until the crimp is completed.
- An equipment grounding conductor bus shall be provided in each controller cabinet. The bus shall be grounded to the cabinet and shall be connected to the metal conduit system or other approved ground with a No. 8, or larger, grounding conductor.

- With all the cabinet equipment in place and connected, the resistance between the grounded conductor terminal bus and the equipment grounding conductor bus shall be 50 MΩ, minimum, when measured with an applied voltage of 150 V (dc).
- If direct current (dc-) is to be grounded, it shall be connected to equipment ground only.
- Two or more terminal blocks shall be provided for field connections. Field terminals shall be installed within 560 mm of the face of the cabinet and shall be oriented for screwdriver operation from the door opening. All terminals shall be a minimum of 125 mm above the foundation.
- No more than 3 conductors shall be brought to any one terminal. Two flat metal jumpers, straight or U shaped, may also be placed under a terminal screw. At least 2 full threads of all terminal screws shall be fully engaged when the screw is tightened. No live parts shall extend beyond the barrier.
- Attention is directed to Section 1.09, "Equipment List and Drawings," regarding wiring diagrams.

The MANUFACTURER shall provide two 18" fluorescent lights mounted inside the top of the front and rear of the cabinet and connected to switches so that the nearest light to the door turns on when opened.

The MANUFACTURER shall provide four (4) cabinet keys and two (2) police box keys with each cabinet.

The MANUFACTURER shall install door switches for both cabinet doors. The switches shall be wired so that when either door is opened, pin 54 of the C-1 plug shall be connected to logic ground.

The CONTRACTOR shall install and orient the cabinet so that the field maintenance technician can observe the traffic signal operation and the controller equipment operation at the same time.

___ 3.03 MODEL 170 LOCAL CONTROLLER ASSEMBLY.

Attention is directed to the provisions in STATE SPECIFICATIONS SECTION 86-3.11, "Model 170 Controller Assemblies," and these special provisions.

As a minimum, the controller assembly shall include the following components:

LOCATION: _____

CONFIGURATION:

Vehicle Phases-Present	N/A
Vehicle Phases-Future	4
Pedestrian Phases-Present	N/A
Pedestrian Phases-Future	2

COMPONENTS:

Description	Model	Quantity
Controller Cabinet with:.....	332.....	1

Input File	2
Output file	1
Power Distribution Assembly Type 2.....	1
Controller	
Controller w/o-PROM Module170E	2
PROM Memory Module w/chips 412B2	3
Modem..... GDI 400.....	2
Switchpack	200 12
DC Isolator 2 Ch.....	242 4
Flasher	204 2
Loop Detector-2 Ch.....	222 22
3M Opticom Discriminator	562 3
Conflict Monitor.....	210PC..... 1

All type 170 controllers shall be provided with dual ACIA's for two-way communications. The dual ACIA's shall be an integral part of the controller unit.

All Type 170 controllers shall be provided with two (2) internal modem slots complete with connectors.

All PROM Memory Modules shall be SAFETRAN model 412B2 and shall be "fully interchangeable" between all manufacturers of 170 controllers. Each PROM module shall be fully populated with one (1) 27256 EPROM chip, one (1) 6064 8K RAM chip and one (1) 1230 32K DRAM chip. The PROM Memory Modules shall be configured for the WAPITI W4IKS software (configuration #1) for each local controller.

Diagnostic Programs for the controller and the cabinet shall be furnished on separate 27256 EPROM chips for each controller and each cabinet.

The conflict monitor shall be a Solid State Devices, Model 210PC, or approved equal, capable of communication with the master controller through the local controller using the Wapiti software.

The modem assembly for a local controller shall be a GDI 400 or approved equal. The modem assembly shall provide communication to and be fully compatible with the existing "On-Street Master" controller modem.

All traffic signal control programs and timings shall be furnished and installed by the City of San Ramon.

The MANUFACTURER shall provide a hard-wired output file with red signal indication monitoring. Field wiring terminal strips shall be capable of accepting up to four (4) conductors for each phase. All terminal lugs on the input harness shall be soldered.

A twelve (12) position terminal strip shall be provided for termination of the interconnect wiring and voice communication lines.

Two (2) C2 connectors with 6 FT cable shall be wired to the twelve position interconnect terminal strip in the cabinets to provide for interconnect to the local controller.

___ **3.04 AUXILIARY EQUIPMENT - LOCAL CONTROLLER.**

The MANUFACTURER shall:

1. Install Ground Fault Interrupter (GFI) type convenience receptacles.
2. Provide either silk screen on metal or phenolic/engraved labels.
3. Provide circuit breakers with their rating engraved/stamped into the handle.
4. Provide a preempt test switch panel in every cabinet. The switches shall be on-off-momentary contact type. The switches shall actuate EVA, EVB, EVC, EVD, RR1, and RR2 and shall be labeled for each function.
5. Provide an installed Bi Trans, Inc. Telephone Interface Module, Model No. CCC1 or approved equal, connected to the twelve position interconnect terminal strip in the cabinet. A wall mount type touch-tone phone shall also be provided.
6. Provide only "CRYDOM" type load switches.

___ **3.04A EMERGENCY VEHICLE PREEMPTION EQUIPMENT.**

The emergency vehicle preemption hardware shall be 3M Traffic Control Devices "Opticom Priority Control System".

The preemption equipment shall be as follows:

1. Detector Unit (ODU) - Model No. 721
2. Optical Emitter System
 - a. Command (High) Priority Light Bar Unit - Model No. 9592.
 - b. Command (High) Priority Unit - Model No. 792H with 793S switch
 - c. Range Setting / Command (High) Priority Unit - Model No. 792R with 793R switch
3. Opticom Phase Selector (Discriminator) Module - Model No. 752.
4. Cable shall be #138 cable as recommended by the manufacturer of the preemption equipment. No splicing of the cable shall be permitted.

The CONTRACTOR shall furnish and install the detector units, discriminator module, and cable as shown on the plans, or described in these provisions. the detector units shall be installed horizontally on the mast arm, and centered over the #1 lane, unless otherwise specified on the plans.

The CONTRACTOR shall furnish to the CITY the following additional emergency vehicle preemption hardware:

- | | |
|--------|--|
| 1 each | Model 721 - 3M Opticom Detector unit |
| 1 each | Model 792H - 3M Opticom Command (High) Priority Emitter System with Model 793S - 3M Opticom Command On/Off Control Switch. |
| 1 each | Model 792R - 3M Opticom Range Setting / Command (High) Priority Emitter System with Model 793R - 3M Opticom Range Setting Command On/Off Control Switch. |

___ **3.05 MASTER CONTROLLER CABINET.**

The master controller cabinet shall be a type 332 anodized aluminum constructed in accordance with Section 86-3.07 of the State Standard Specifications.

The MANUFACTURER shall provide:

1. A thermostatically controlled electric fan mounted within the cabinet and vented.
2. An intake filter and shell mounted over the air intake vents.
3. An 18" fluorescent light mounted inside the top of the cabinet and connected to switch so that the light is on when the front door of the cabinet is open.
4. Two (2) cabinet keys with each master cabinet.

The CONTRACTOR shall install the cabinet at the location as shown on the plans. The cabinet shall be orientated as directed by the CITY INSPECTOR.

3.06 MODEL 170 MASTER CONTROLLER ASSEMBLY.

Attention is directed to the provisions in STATE SPECIFICATIONS SECTION 86-3.11, "Model 170 Controller Assemblies," and these special provisions.

As a minimum, the master controller assembly shall include the following components:

LOCATION: < Location of master cabinet >

COMPONENTS:

Description	Model	Quantity
Controller Cabinet with:.....	332	1
Rack Cage with side panels.....	1
Power Plug Assembly.....	1
Master Controller		
Controller w/o-PROM Module	170	1
PROM Memory Module w/chips	412B2	2
Modem.....	GDI 400	1
Modem (Smart)	GDI 2400SM.....	2

The MANUFACTURER shall provide:

1. A power line service terminal block mounted on the rack cage side panel and covered with a clear insulating material to prevent inadvertent contact.
2. A power plug assembly consisting of one (1) 20 amp circuit breaker, one (1) Ground Fault Interrupter (GFI) type receptacle, and two (2) duplex receptacles installed on a rack mount panel attached to the rack cage and wired to the power line service terminal block.
3. Two (2) twelve (12) position terminal strip mounted on the rack cage side panel for the termination of the interconnect wiring and voice communication lines.

4. Two (2) C2 connectors with 6 feet cables wired to the two (2) twelve (12) position interconnect terminal strips.

All type 170 controllers shall be provided with dual ACIA's for two way communications. The dual ACIA's shall be an integral part of the controller unit.

All Type 170 controllers shall be provided with two (2) internal modem slots complete with connectors.

All PROM Memory Modules shall be SAFETRAN model 412B2 and shall be "fully interchangeable" between all manufacturers of 170 controllers. Each PROM module shall be fully populated with one (1) 27256 EPROM chip, one (1) 6064 8K RAM chip and one (1) 1230 32K DRAM chip.

The PROM Memory Modules shall be configured for the WAPITI W7OSM "On Street" master software (configuration #2). Diagnostic Programs for the controller and the cabinet shall be furnished on a separate 27256 EPROM chips.

The modem assemblies for a master controller shall be one (1) GDI 400 modem and two (2) GDI 2400SM smart modem or approved equal. The modem assemblies shall provide communication to and be fully compatible with the existing local controller modem.

All master control programs and timings shall be furnished and installed by the City of San Ramon.

___ 3.07 AUXILIARY EQUIPMENT - MASTER CONTROLLER.

The MANUFACTURER shall provide:

1. Either silk screen on metal or phenolic/engraved labels.
2. Circuit breakers with their rating engraved/stamped into the handle.
3. A digital 1/0 Wraparound Connector for the C1 plug, and a "Communications Wraparound Connector" for the C2 plug for the "On-Street Master" controller.
4. An installed Bi Trans, Inc. Telephone Interface Module, Model No. CC1. or approved equal, connected to the twelve position interconnect terminal strip in the cabinet.
5. Two (2) wall mount type touch-tone phones.

___ 4.00 TRAFFIC SIGNAL FACES AND FITTINGS.

___ 4.01 VEHICLE SIGNAL HEADS.

All signal head housings shall be the metallic type. Signal head lenses gaskets SHALL NOT be constructed from "Neoprene." All lenses shall be glass. Polycarbonate reflectors shall not be furnished.

All traffic signal heads, visors, and frameworks shall be "factory powder coat" painted in lieu of conventional painting in accordance with section 10-2.10, "Painting". All signal heads shall be factory assembled and tagged by location and intersection. Signal heads and frameworks, as a unit, shall be assembled and installed by the CONTRACTOR.

Extreme care shall be taken not to damage the surface. Any scar marks or cosmetic damage to the equipment caused from tools or installation processes shall be cause for rejection.

The CONTRACTOR shall exercise care at the time the signal heads are installed to insure that the gaskets provided for the mounting of the heads are installed on the outside of the using to provide a watertight seal. Gaskets shall not be placed on the inside of the housing.

The final placement, aiming, and configuration of the signal heads and frameworks shall be subject to the approval of the CITY INSPECTOR.

Signal lamps shall be furnished and installed by the CONTRACTOR. Lamps for 12-inch green and yellow heads shall be 1950 Lumen traffic signal lamps.

4.02 OPTICAL UNITS – LIGHT EMITTING DIODES.

Definition

All traffic signals faces on this project shall utilize Type 1 light emitting diode signal modules as described herein.

Each light emitting diode (LED) signal module shall consist of an assembly that utilizes light emitting diodes as the light source in lieu of an incandescent lamp for use in traffic signal sections.

Each Type 1 LED signal module shall be designed to be installed in the doorframe of a standard traffic signal housing.

General

LED signal modules used on this project shall be from the same manufacturer, and each size shall be the same model.

Each Type 1 LED signal module shall be a sealed unit with two conductors for connecting to power, a printed circuit board, power supply, a lens and gasket, and shall be weatherproof after installation and connection. The circuit board and power supply shall be contained inside the module. Circuit boards shall conform to Chapter I, Section 6 of the "Transportation Electrical Equipment Specifications".

The lens of the Type 1 module shall be integral to the unit, shall be convex with a smooth outer surface and made of ultraviolet stabilized plastic or of glass. The lens shall be capable of withstanding ultraviolet (direct sunlight) exposure for a minimum period of 5 years without exhibiting evidence of deterioration.

The Type 1 module shall be sealed in the doorframe with a one-piece EPDM (ethylene propylene rubber) gasket.

The LEDs shall utilize AlInGaP technology and shall be the ultra bright type rated for 100,000 hours of continuous operation from -40°F to 165°F (-40°C to 74°C).

The individual LEDs shall be wired such that a catastrophic failure-of one LED will result in the loss of not more than 5 percent of the signal module light output.

The failure of an individual LED in a string shall only result in the loss of that LED, not the entire string or indication.

The LED signal modules tested or submitted for testing shall be representative of typical average production units. Circular modules shall be tested according to California Test No.604. All optical testing shall be performed with the module mounted in a standard traffic signal section but without a visor or hood attached to the signal section. Maximum initial power requirements for LED signal modules shall be 25 watts for 12-inch red, 15 watts for 8 inch red and 15 watts for 12-inch red arrow at 77°F (25°C).

LED signal modules shall be rated for a minimum useful life of 48 months and shall maintain not less than 85 percent of the standard light output values found in the ITE publication ST -008B, "Vehicle Traffic Control Signal Heads" (VTCSH ST-017), after 48 months of continuous use in a traffic signal operation over the temperature range of 104°F to +165°F (40°C to +74°C).

In addition to the requirements for circular LED signal modules, arrow modules shall conform to the following:

The LED arrow indication shall meet existing specifications stated in the VTCSH Section 9.01 for arrow lenses. The LEDs shall be spread evenly across the illuminated portion of the arrow area. Each LED signal section indication shall provide a minimum average luminous intensity of 5,500 candela/m², as measured by the VTCSH. All measurements shall be performed at rated operating voltage of 120 V AC.

Physical and Mechanical Requirements

LED traffic signal modules shall be designed as retrofit replacements for existing optical units of signal lamps and shall not require special tools for installation. LED signal modules shall fit into existing traffic signal section housings built to the VTCSH without modification to the housing.

Installation of a LED signal module shall only require the removal of the lens and signal bulb, and shall be weather tight and fit securely in the housing.

LED Signal Module Lens.

The LED signal module shall be capable of replacing the optical unit. The lens may be tinted or may use transparent film or materials with similar characteristics to enhance ON/OFF contrasts. The use of tinting or other materials to enhance ON/OFF contrasts shall not affect chromaticity and shall be uniform across the face of the lens. If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance.

Environmental Requirements

The LED signal modules shall be rated for use in the operating temperature range of -40°C (-40°F) to +74°C (+165°F).

The LED signal module shall be protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal components.

The LED signal module lens shall be UV stabilized.

Construction

The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The power supply for the LED signal module shall be integral to the unit.

The assembly and manufacturing process for the LED signal assembly shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Materials

Material used for the lens and signal module construction shall conform to ASTM specifications for the materials where applicable.

Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials. The lens of the signal module is excluded from this requirement.

Module Identification

Each LED signal module shall have the manufacturer name, trademark, and other necessary identification permanently marked on the back of the module. Each individual LED signal module shall be identified for warranty purposes.

The following operating characteristics shall be identified: rated voltage, power consumption, and volt ampere.

Each Type 1 LED signal modules shall have prominent and permanent vertical marking(s) for correct indexing and orientation within a signal housing. The markings shall consist of an up arrow or the word "UP" or "TOP".

Photometric Requirements

All LED traffic signal modules shall meet at least 85 percent of the minimum VTCSH intensity requirements while operating throughout the operating temperature range of -40°F (-40°C) to 165°F (74°C).

The minimum initial luminous intensity values for LED traffic signal modules shall be as defined in Section 1.04 of the VTCSH standard at 77°F (25°C).

The measured chromaticity coordinates of LED signal modules shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the VTCSH standard.

Electrical

LED signal modules shall operate from a 60HZ ± 3 HZ AC line over a voltage ranging from 80 volts to 135 volts. The LED circuitry shall prevent perceptible flicker over the voltage range specified above. The fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications. Rated voltage for all measurements shall be 120 volts.

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the VTCSH standard. Two secured, color coded, 36 in. (914mm) long 600V, 20 AWG

minimum, jacketed wires, conforming to the National Electric Code, rated for service at 221°F (105°C), are to be provided for electrical connection for each Type 1 LED signal module.

The signal module onboard circuitry shall include voltage surge protection to withstand high repetition noise transients as stated in Section 2.1.6 of NEMA Standard TS-2, 1992.

LED signal modules shall be operationally compatible with currently used controller assemblies (solid state load switches, flashers, and conflict monitors).

LED signal modules and associated on board circuitry must meet Federal Communications Commission (FCC) Title 47, Sub Part B, Section 15 regulations concerning the emission of electronic noise.

The LED signal module shall provide a power factor of 0.90 or greater. Total harmonic distortion (current and voltage) induced into an AC power line by an LED signal module shall not exceed 20 percent.

Quality Assurance

LED signal modules shall be manufactured in accordance with a vendor quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of LED signal modules built to meet this specification.

QA process and test results documentation shall be kept on file for a minimum period of seven years.

LED signal module designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

Manufacturer's Information

The manufacturer's name, trademark, serial number, date of manufacture, and other necessary identification shall be permanently marked on the backside of the LED signal module. A label shall be placed on the LED signal module certifying compliance to these specifications and showing the date of installation.

Production Quality Assurance Testing

The following Production Quality Assurance tests shall be performed on each new LED signal module prior to shipment. Failure to meet requirements of any of these tests shall be cause for rejection. The manufacturer for warranty purposes shall retain test results for seven years.

The LED signal indications shall include the following criteria:

1. Each LED signal module shall have:

- a) A smooth surfaced colored (red or yellow) UV stabilized polycarbonate outer shell,
- b) Multiple LED light sources,
- c) A regulated power supply,
- d) A polycarbonate back cover assembled with silicon seals

- e) The LED's are to be mounted on a polycarbonate positioning plate.
- 2. A mechanical alignment and assembly mechanism must ensure that each LED is retained in the pre-determined position.
- 3. The modules shall consist of an assembly comprising:
 - a) An internal beam controlling optical faceted lens.
 - b) A minimum of 300 LED's for twelve inch "BALL" indications
 - c) A minimum of 100 LED's for twelve inch "ARROW" indications.
- 4. The leads of LEDs shall be kept at full length to improve heat dissipation from LEDs.

TESTING

Each LED signal module shall be tested for light output at 90 and 120 volts. LED signal modules shall not be allowed to fall short of the minimum intensity values at any of the 44 measuring points of the standard when the lamp is turned on cold for measurement and after a 30-minute warm-up period at 100 percent duty cycle.

The LED signal modules shall be operationally compatible with currently used controllers and conflict monitors.

The LED signal module will be replaced or repaired by the manufacturer if it exhibits a failure due to workmanship or material defects within the first 60 months of field operation. For security purposes, if any one LED circuit should fail, it should be easily identifiable by visual inspection and replaced or repaired as per the above warranty.

All LED indications shall be DIALIGHT series or approved equal.

___ 4.03 DIRECTIONAL LOUVERS.

Where shown on the plans, directional louvers shall be furnished and installed in signal visors. Directional louvers shall be so constructed as to have a snug fit in the signal visors. The outside cylinder shall be constructed of 0.003 in. (0.75-mm) nominal thickness, or thicker, sheet steel and the vanes shall be constructed of 0.0157 in. (0.4-mm) nominal thickness, or thicker, sheet steel or the cylinder and vanes shall be constructed of 5052-H32 aluminum alloy of equivalent thickness. Dimensions of louvers and arrangements of vanes shall be as shown on the plans.

___ 4.04 BACKPLATES.

Backplates shall be installed on all traffic signal heads unless noted otherwise on the plans. All backplates shall be made of metal and may consist of two (2) or more sections. All backplates shall have a black lusterless finish.

___ 4.04 PROGRAMMED VISIBILITY (PV) VEHICLE SIGNAL FACES.

Programmed visibility heads shall not be used unless noted otherwise on the plans.

___ 4.05 PEDESTRIAN SIGNAL FACES.

Pedestrian signals shall be LED Type "Countdown" modules. The gaskets for the mounting of pedestrian signal heads shall be installed on the outside of the housing to provide a watertight seal. The CONTRACTOR shall take extra care to ensure that the gasket is properly installed.

Terminal compartments shall be bronze; framework, elbows and curved washers shall be bronze, or galvanized steel.

All pedestrian heads, visors and frameworks shall be "factory powder coat" painted in lieu of conventional painting. All heads shall be factory assembled with their respective frameworks and tagged by location and intersection. Pedestrian heads and frameworks, as a unit, shall be installed by the contractor's workers at the job site. Extreme care shall be taken by the contractor's workers during the installation of the signals, frameworks and heads. Any scar marks, or cosmetic damage to the equipment caused from tools or installation processes shall be cause for rejection.

The factory powder coat finish shall be applied as described below:

- (1) Pretreatment Process
 - (a) Acid etch degreasing bath
 - (b) Clean water rinse
 - (c) Iron phosphate adhesion bath
 - (d) Clean water rinse
 - (e) Non-chromate acidulated seal bath
- (2) Thermal set process
 - (a) Convey parts through drying oven for 10 minutes at 149 to 399 deg/F (204 deg/C).
 - (b) Apply polyester or epoxy-based dry powder coating at 75-90 KV.
 - (c) Convey parts through curing oven for thermal setting for 20 minutes at 399 deg/F (204 deg/C).

4.05A LIGHT EMITTING DIODE PEDESTRIAN SIGNAL FACE MODULES

Light emitting diode (LED) pedestrian signal face (PSF) modules shall be installed in a standard pedestrian signal housing, displaying "UPRAISED HAND," "COUNTDOWN DIGITS" and "WALKING PERSON," and shall use light emitting diodes as the light source as shown on the plans and in conformance with these special provisions.

GENERAL

PSF modules shall be a single, self-contained device, not requiring on-site assembly for installation into existing traffic signal housing. PSF modules shall be designed to mount behind or replace faceplates of standard housings in conformance with the requirements of the Institute of Transportation Engineers (ITE) Standards: "Pedestrian Traffic Control Signal Indications" and the "Manual on Uniform Traffic Control Devices" (MUTCD). PSF modules used on this project shall be from a single manufacturer.

LEDs for "COUNTDOWN" indications shall be the ultra bright type rated for 100,000 hours of continuous operation from -40°F (-40°C) to +165°F (74°C).

Individual LEDs shall be wired so that a total failure of one LED will result in the loss of not more than 5 percent of the PSF module light output. Failure of an individual LED in a string shall not result in the loss of the entire string or any other indication.

PSF modules tested and those submitted for testing shall be representative of typical production units. PSF modules shall be tested in conformance with California Test 610 and as specified herein.

Luminance Requirements

Luminance of the displaying "UPRAISED HAND," and "COUNTDOWN DIGITS" shall be 350 cd/sq. ft. (3750 cd/m²) minimum. Color of "UPRAISED HAND," and "COUNTDOWN DIGITS" indications shall be Portland orange conforming to the requirements of the ITE Standards: "Pedestrian Traffic Control Signal Indications" and the MUTCD.

Luminance of the "WALKING PERSON" symbol shall be 490 cd/sq. ft. (5300 cd/m²) minimum. Color of "WALKING PERSON" shall be white (Luminous Tubing) conforming to the requirements of the ITE Standards: "Pedestrian Traffic Control Signal Indications" and the MUTCD.

Height and width of each symbol shall not be less than 10 inches (250 mm) and 6.5 inches (165 mm) respectively. Uniformity ratio of illuminated symbols shall not exceed 4 to 1 between the highest luminance area and the lowest luminance area.

PSF modules shall be rated for a minimum useful life of 36 months and shall maintain at least 85 percent of 350 cd/sq. ft. 3750 cd/m² for "COUNTDOWN" indications and 85 percent of 490 cd/sq. ft. 5300 cd/m² for "WALKING PERSON" symbols after 36 months of continuous use in traffic signal operation over a temperature range of -40°F (-40°C) to +165°F (74°C).

Physical and Mechanical Requirements

PSF modules shall be designed as retrofit replacement for existing optical units of signal lamps, or existing pedestrian signal faces with both LED and incandescent light sources, and shall not require special tools for installation. PSF modules shall fit into pedestrian signal section housings built in conformance with the ITE Publication: Equipment and Materials Standards, Chapter 2 "Vehicle Traffic Control Signal Heads" (VTCSH) without modification to the housing.

Installation of PSF modules into pedestrian signal faces shall require only removal of lenses, reflectors, lamps and existing LED modules as indicated on the plans.

Environmental Requirements

PSF modules shall be rated for use in the operating temperature range of -40°F (-40°C) to +165°F (74°C).

The LED countdown module shall be completely sealed against dust and moisture intrusion per the requirements of NEMA Standard 250.

Construction

PSF modules shall be single, self-contained devices, not requiring on-site assembly for installation into standard housings. Power supplies for PSF modules shall be integral to the modules.

Assembly and manufacturing processes for PSF modules shall be designed to assure all internal components will be adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Three secured, color-coded (blue, red, white), 36-inch long, 600V 16 AWG jacketed wires, rated for service at +221°F (105°C), shall be provided for electrical connections.

Materials

Material used for PSF modules shall conform to the requirements in ASTM specifications for the materials.

Enclosures containing either the power supply or electronic components of the PSF module shall be made of UL94VO flame-retardant materials.

Module Identification

PSF modules shall have the manufacturer's name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics permanently marked on the back of the module. Required operating characteristics shall include rated voltage, power consumption and volt-ampere (VA).

PHOTOMETRIC REQUIREMENTS

PSF modules shall maintain at least 85 percent of the following luminous intensity values over 36 months of continuous use in signal operation over the temperature range of -40°F (-40°C) to +165°F (74°C). In addition, PSF modules shall meet or exceed the following luminous intensity values upon initial testing at 77°F (25° C).

Chromaticity

The measured chromaticity coordinates for the "lunar white" walking man and the Portland orange" hand and digits shall conform to the requirements for chromaticity in Section 8.04 and Figure 1 of the VTCSH standards.

The chromaticity measurements shall remain unchanged over the input line voltage range of 80 VAC to 135 VAC.

Display

The LED countdown signal module shall consist of a double overlay message combining the symbols of a hand and a walking man and two 7-segment digits.

The LED's shall be arranged in a manner to form an outline of symbols.

The shape of the outline shall conform to the standard symbols for pedestrian signals.

The LED's shall be distributed evenly along the message outline. The distance between each LED shall not vary more than 10%.

The hand/man symbols shall not be less than 10 " in height and 6.5" in width and shall be made of at least 72 high-intensity LED's for each one of the hand/man symbols in order to assure adequate luminous intensity.

The countdown digits shall be 8" high and shall be made of at least 88 LED's

The "Portland orange" LED's shall be of the latest AlIn GaP technology and the "lunar white" LED's of the latest GaN technology.

The individual LED light sources shall be interconnected so that a catastrophic failure of a single LED will result in a total loss of not more than 3 LED's or 5% of the signal light output.

There shall be no electronic components visible on the front of the display face. The display face shall consist solely of LED's mounted on a mat black PCB.

Drive Circuitry

The driver board shall drive the LED's at a DC current not exceeding the maximum rating recommended by the LED manufacturer (20ma).

The driver board shall regulate the LED drive current on both the hand/man messages to compensate for the line voltage fluctuations over the range of 80VAC to 135 VAC. The luminous output shall not vary more than 10% of the voltage range and shall not be perceptible to the human eye.

The drive circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992.

The on-board circuitry shall meet FCC Title 47, Sub-part B, Section 15 regulations concerning the emission of electronic noise.

The circuitry shall ensure compatibility and proper triggering and operation of the load switches and conflict monitors in signal controllers currently in use by the procuring traffic authority.

Countdown Functionality

The countdown module shall be compatible with all types of traffic controllers.

The countdown timer module shall have a microprocessor capable of setting it's own time when connected to a traffic controller.

When connected, the module shall continuously monitor the traffic controller for any changes to the pedestrian phase time and reprogram itself automatically if needed.

The countdown module shall register the time for walk and clearance intervals individually and shall begin counting down from the sum of both interval times.

When the walk interval is pre-empted, the countdown module shall also pre-empt and skip directly to the clearance interval and countdown to reach 0 at the same time as the solid hand.

In the cycle following a pre-motion call, when the module completes the walk interval countdown and the clearance interval has not yet started, the module shall display the clearance time and wait for the flashing hand to resume the countdown.

When the flashing hand becomes solid, the module shall display 0 for one second, and then blank out.

The countdown module shall have an internal conflict monitor to prevent any possible conflicts between the hand/man signal indications and the time display.

When the countdown module is installed in a coordinated system and the walk interval time changes at every cycle, it shall be possible to blank out the walk time, and display only the clearance time.

The countdown module shall have dip-switches for the following user selectable options:

- 1-display 0 during stand-by.
- 2-turn on LED's for testing
- 3-"Coordinated" mode, (displays clearance time only)
- 4- disables dimming feature
- 5-30-sec. delay on dimming
- 6-disables countdown display

The LED module shall have a removable plug on the rear of the unit to allow for on-site firmware upgrades and easy access to dip switches.

Dimming

In order to reduce long-term degradation to LED's, the signal modules shall be designed to reduce the intensity of light output by 30% in response to diminished ambient light level.

The dimming circuit shall have a 30-sec. delay to prevent interference caused by shadows or headlights.

LED drive current regulation shall not be diminished when in dimmed condition.

A switch or jumper connector shall be provided to allow disabling of dimming feature.

ELECTRICAL

PSF module power consumption shall not exceed the following maximum values:

PSF modules shall operate at a frequency of 60 Hz: 3 Hz over a voltage range from 95 V (AC) to 135 V (ac) without perceptible flicker. Fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications. Rated voltage for all measurements shall be 120 V (AC).

PSF module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients in conformance with the requirements in Section 2.1.6 of NEMA Standard TS2-1992.

Wiring and terminal blocks shall conform to the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, "Vehicle Traffic Control Signal Heads."

PSF Module	Power Consumption @ 77°F (25°C)	Power Consumption @ 165°F (74°C)
COUNTDOWN INDICATION	10.0 W	12.0 W
WALKING PERSON	12.0 W	15.0 W

PSF modules shall be operationally compatible with currently used controller assemblies including solid state load switches, flashers and conflict monitors. When a current of 20 milliamperes (ac) or less is applied to the unit, the voltage read across the two leads shall be 15 V (ac) or less.

PSF modules and associated on-board circuitry shall conform to the requirements in Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

PSF modules shall provide a power factor of 0.90 or greater.

Total harmonic distortion from current and voltage induced into an alternating current power line by PSF modules shall not exceed 20 percent at an operating temperature of 77°F (25° C).

QUALITY CONTROL PROGRAM

PSF modules shall be manufactured in conformance with a vendor quality control (QC) program. The QC program shall include two types of testing: (1) design qualification and (2) production quality. Production quality testing shall include statistically controlled routine tests to ensure minimum performance levels of PSF modules built to meet these specifications.

Documentation of the QC process and test results shall be kept on file for a minimum period of seven years.

PSF module designs not satisfying design qualification testing and the production quality testing performance requirements specified herein shall not be labeled, advertised or sold as conforming to these specifications.

Identification of components and subassemblies of PSF modules, which may affect reliability and performance, shall be traceable to the original manufacturers.

Design Qualification Testing

The manufacturer shall perform design qualification testing (DQT) or an independent testing lab hired by the manufacturer on new PSF module designs, and on existing designs when a major design change has been implemented. Failure to conform to the requirements of any design qualification test shall be cause for rejection.

A major design change is defined as a design change, electrical or physical, which changes any of the performance characteristics of the PSF module, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the PSF module.

Two PSF modules for each design shall be used for DQT. The two PSF modules shall be selected at random. These PSF modules shall be submitted to the Transportation Laboratory after the DQT is complete. The testing data shall be submitted with the PSF modules to the Transportation Laboratory for verification of DQT data.

The PSF modules shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of 165°F (74° C) before performing any DQT.

After burn-in, the PSF modules shall be tested for rated initial luminous intensity in conformance with the provisions in "Photometric Requirements." Before measurement, PSF modules shall be energized at rated voltage, with 100 percent on-time duty cycle, for a time period of 30 minutes. The ambient temperature for these measurements shall be

25°C. The test results shall include the recorded current, voltage, total harmonic distortion (THD) and power factor (PF) associated with each measurement.

PSF modules shall be tested by measuring for chromaticity (color) in conformance with the provisions in "Photometric Requirements." A spectra radiometer shall be used for these measurements. The ambient temperature for these measurements shall be 77°F (25°C).

PSF modules shall be tested by measuring for current flow in amperes. The measured current values shall be used for comparison of production quality assurance on production modules.

PSF modules shall be tested by measuring for power factor. A commercially available power factor meter may be used to perform this measurement.

PSF modules shall be tested by measuring for total harmonic distortion. A commercially available total harmonic distortion meter may be used to perform this measurement.

PSF modules shall be tested in conformance with the provisions in "Electrical," with reference to Class A emission limits referenced in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15.

PSF modules shall be tested for compatibility with the controller unit, conflict monitor and load switch. Each PSF module shall be connected to the output of a standard load switch connected to an alternating current voltage supply between the values of 95 and 135 V (ac) with the input to the load switch in the "OFF" position. The alternating current voltage developed across each PSF module shall not exceed 10 V nns as the input alternating current voltage is varied from 95 V (ac) nns to 135 V (ac) nns.

PSF modules shall be tested for transient immunity in conformance with the provisions in "Electrical" and conforming to the procedure described in NEMA Standard TS2-1992. Mechanical vibration testing shall be performed on PSF modules in conformance with the requirements in MIL-STD-883, Test Method 2007, using three 4-minute cycles along each x, y, and z axis, at a force of 2.5 Gs, with a frequency sweep from 2 Hz to 120 Hz. The loosening of the *lens*, of any internal components, or other physical damage shall be cause for rejection.

Temperature cycling shall be performed on PSF modules in conformance with the requirements of MIL-STD-883, Test Method 1010. The temperature range shall conform to the provisions in "Environmental Requirements." A minimum of 20 cycles shall be performed with a 30-minute time between temperature extremes and a 30-minute dwell time at each temperature. Signal under test shall be non-operating. Failure of PSF modules to function properly or evidence of cracking of PSF module lenses or housings after temperature cycling shall be cause for rejection.

Moisture resistance testing shall be performed on PSF modules in conformance with the requirements in NEMA Standard 250-1991 for Type 4 enclosures. Evidence of internal moisture after testing shall be cause for rejection.

Production Quality Testing

Production quality tests shall be performed on each PSF module prior to shipment. Failure to conform to the requirements of any production quality tests shall be cause for rejection. The manufacturer shall retain test results for seven years for warranty purposes.

PSF modules shall be tested for rated initial intensity after burn-in. The burn-in period shall consist of signal modules being energized at rated voltage for a 30-minute stabilization period before the measurements are made.

PSF modules shall be tested for luminous intensity requirements in "Photometric Requirements." PSF modules shall be tested for required power factor after burn-in.

PSF modules shall be tested by measuring current flow in amperes after burn-in. The measured current values shall be compared against current values resulting from design qualification measurements under "Design Qualification Testing." The current flow shall not exceed the rated value. The measured ampere values with rated voltage shall be recorded as volt-ampere (V A) on the product labels.

PSF modules shall be visually inspected for any exterior physical damage or assembly anomalies. The surface of the lens shall be free of scratches, abrasions, cracks, chips, discoloration, or other defects. Any such defects shall be cause for rejection.

CERTIFICATE OF COMPLIANCE

The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer, in conformance with the provisions of Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall certify that the PSF modules comply with the requirements of these specifications. The certificate shall also include a copy of all applicable test reports on the PSF modules.

QUALITY ASSURANCE TESTING (RANDOM SAMPLE TESTING)

The City may perform random sample testing on all shipments. Random sample testing will be completed within 30 days after delivery to the City of San Ramon Public Services Division, 5000 Crow Canyon Road, San Ramon, CA. PSF modules shall be tested in conformance with California Test 606 and these special provisions. Optical testing shall be performed with the module mounted in a standard traffic signal section or in a standard Type A pedestrian housing, but without a visor or hood attached to the section or housing. The number of modules tested shall be determined by the quantity of each model in the shipment. The sample size shall conform to ANSI/ASQC 21.4. The City of San Ramon Public Services Division shall determine the sampling parameters to be used for the random sample testing. All parameters of the specification may be tested on the modules. Acceptance or rejection of the shipment shall conform to ANSI/ ASQC 21.4 for random sampled shipments.

WARRANTY

The manufacturer shall provide a written warranty against defects in materials and workmanship for the PSF modules for a period of 60 months after installation of the PSF modules. Replacement PSF modules shall be provided within 5 days after receipt of

failed PSF modules at no cost, except the cost of shipping the failed modules. All warranty documentation shall be given to the Engineer.

___ 4.06 SIGNAL MOUNTING ASSEMBLIES.

All overhead left turn movement signal heads shall be mounted on the mast arm with MAT mounts and all overhead through movement signal heads shall be mounted on the mast arm with MAS mounts.

Terminal compartments, MAS and MAT mounts, serrated washers, and slip fitters shall be bronze.

“KO” type seals are not acceptable for sealing unused pipe thread connections to terminal compartments, or top/bottom of signal heads. Connections shall be sealed with threaded type fittings with a rubber gasket.

___ 4.07 FLASHING BEACONS

___ 4.07A FLASHING BEACONS – TRAIL SIDE MOUNT.

The flashing beacons installation shall include one flashing beacon mounted on a pole at two (2) locations, a controller mounted on a separate pole, and a power pedestal.

The flashing beacons shall be mounted on a Type 1 or Type 1B pole as shown on the plans. Each beacon shall include:

1. One (1) single 12 inch section signal head,
2. One (1) 12 inch yellow LED signal insert,
3. One (1) PEC controlled incandescent sign light,
4. One (1) high reflective sign panels.

The flashing beacon controller shall be installed in a NEMA 3R hinged door rain tight enclosure and shall consist of:

1. A plug-in solid state model 204 flasher,
2. A 365 day solid state programmable time clock,
3. An adjustable delay timer,
4. An adjustable duration timer,
5. A PEC circuit to turn on/off the incandescent sign light,
6. A disconnect circuit breaker.

The controller enclosure shall be mounted on an eight (8) foot Type 1-B pole by means of a Pelco Astro Bracs or approved equal, The PEC shall be mounted on top of the pole.

The CONTRACTOR shall submit for approval, three (3) copies of the circuit diagram prior to the construction/assembly of the flashing beacon controller.

The Type IIIAF service cabinet shall conform to STATE SPECIFICATIONS SECTION 86-2.11 “Service” and shall contain items 1 through 8, item 13, item 15, items 20 through 22, and items 24 through 25 as shown on S.S.P. sheet ES-2d.

The flashing beacons shall not be equipped with dimming relays.

The power pedestal, controller enclosure, and Type 1-B pole shall be anodized aluminum conforming to Section 86-3.04 of the Standard Specifications.

The flashing beacon poles shall be located adjacent to the trail or as shown on the plans. The CONTRACTOR shall mark the location in the field and the INSPECTOR shall review the locations prior to any installation.

A sensor unit shall be mounted on the top of the flashing beacon pole and aimed down the trail to detect approaching pedestrians and bicyclists. The sensor shall activate the flashing beacon. The sensors shall not detect pedestrians and bicyclists moving away from the crossing. The sensors shall be "Microwave Sensors, model TC-20" or approved equal.

The LED signal modules shall conform to Section ____ 4.02 "Optical Units – Light Emitting Diodes" and shall be yellow in color.

____ 4.07B FLASHING BEACONS - SIDE MOUNT.

The flashing beacon installation shall include one or more flashing beacons mounted on a pole, a controller, and a power pedestal.

The flashing beacons shall be mounted on a type 1 or type 1B pole as shown on the plans. Each beacon shall include:

1. Two (2) single 12 inch section signal heads or one (1) triple, 12 inch section, signal head with the center section blanked out,
2. Two (2) 12 inch yellow LED signals,
3. One (1) PEC controlled incandescent sign light,
4. One (1) high reflective sign panel.

The flashing beacon controller shall be installed in a NEMA 3R hinged door raintight enclosure and shall consist of:

1. A plug-in solid state model 204 flasher,
2. A 365 day solid state programmable time clock,
3. An adjustable delay timer,
4. An adjustable duration timer,
5. A PEC circuit to turn on/off the incandescent sign light,
6. A disconnect circuit breaker.

The controller enclosure shall be mounted on a Type 1-B pole by means of a Pelco Astro Bracs or approved equal, The PEC shall be mounted on top of the pole.

The CONTRACTOR shall submit for approval three (3) copies of the circuit diagram prior to the construction/assembly of the flashing beacon controller.

The Type IIIAF service cabinet shall conform to STATE SPECIFICATIONS SECTION 86-2.11 "Service" and shall contain items 1 through 8, item 13, item 15, items 20 through 22, and items 24 through 25 as shown on S.S.P. sheet ES-2d.

The flashing beacons shall not be equipped with dimming relays.

The power pedestal, enclosure, shall be anodized aluminum conforming to Section 86-3.04 of the Standard Specifications.

The LED signal module shall conform to Section ____ 4.02 "Optical Units – Light Emitting Diodes" and shall be yellow in color.

____ **4.08 LED EXTINGUISHABLE MESSAGE SIGNS.**

____ **4.08A LED EXTINGUISHABLE MESSAGE SIGNS - "PREPARE TO STOP".**

The extinguishable message signs shall use Light Emitting Diode (LED) technology to create the Message "Prepare to Stop". The message shall only be visible from the front of the sign.

The enclosure shall be 3' by 4' by 6" deep, with the top, bottom, sides, and back constructed of aluminum. The enclosure shall be weather tight meeting the requirements of NEMA standards 3R and shall be vented on the bottom.

The front of the sign shall be constructed with a transparent Polycarbonate or hardened acrylic panel contained within an extruded 0.090 aluminum frame. The frame shall have full welded seams. The frame shall be attached to the enclosure with a continuous stainless steel piano hinge to allow access to the interior of the sign and secured with stainless steel latches. The enclosure and frame shall be powder coat painted with high gloss textured black finish (Federal Specification 595b #17038).

A 3/8" black anodized aluminum hex cell louver having 95% open area and providing 60 degree shielding shall be installed behind the front panel and fastened to it with clips so that it can be removed for cleaning and maintenance.

Each enclosure shall be mounted on a 1-B pole below an existing flashing beacon using Pelco Astro Bracs or approved equal.

The extinguishable message shall be made up of 5" by 7" LED modules mounted on rails within the enclosure. Each Module shall comprise one letter of the message. Each module shall be removable from the enclosure without the use of any tools other than a screwdriver.

Each LED module shall be comprised of pixels (clusters). Each pixel shall be constructed from a 1" dia. black plastic tube, 1.5" in length and include eight (8) LED's. Each pixel shall be removable from the module without the use of any tools other than a screwdriver.

The individual LED's shall be high power AlInGaP amber type as manufactured by Hewlett-Packard (catalog #HLMA-DLOO) or approved equal.

All of the elements of the extinguishable message sign shall be powered by a 24VDC power supply. The power supply shall be mounted in the enclosure. A 15-amp circuit

breaker shall be mounted in the enclosure so that the 120VAC-power source from the traffic signal controller cabinet can be disconnected to allow maintenance of the power supply and the individual modules. All electrical connections between the power supply and the individual pixels shall be plug and socket type and accomplished with out the use of any tools.

The extinguishable message sign shall be turned on and off by means of a 120VAC input from the traffic signal controller cabinet. An integrated control circuit shall flash the extinguishable message sign and the flashing beacons alternately. The flash rate and the delay on and the delay off times shall be adjustable. The LED message shall automatically adjust its light output by means of photo sensors installed in the enclosure and shall be proportional to the ambient light.

Each 12" flashing beacon shall be modified to accept an LED signal module. The modification will include the removal of the lamp, socket, reflector, and lens assembly, and the installation of the LED module.

The LED signal module shall conform to Section ____ 4.02 "Optical Units – Light Emitting Diodes" and shall be yellow in color.

____ 4.09 AUDIBLE PEDESTRIAN SIGNALS

The Contractor shall furnish Novax Audible Pedestrian signal or City-approved equivalent prior to bid. The audible pedestrian signal shall meet the following specifications:

- Size: 5.00" High, 3.75" Wide, 5.00" Deep
- Power Requirement: 115VAC \pm 20 VAC, 60 Hz, 3 Watts
- Temperature Range: -37 to +74 Degrees Celsius
- Output: 90db per watt at one (1) meter with proportional control, output will self adjust from a minimum volume setting to 90 decibels based on street level noise.
- The unit shall be completely weatherproof free of exposed wiring.

Audible output sound shall be as follows:

- "Cuckoo" North-South audible signal (Electronic Bird Chirp) by method of electronic alternating high and low tones; Period: 1.5 seconds \pm 20%; Duration of 0.6 seconds \pm 20%; Frequency base of 1,100 Hz \pm 20%; with frequency deviation +120 Hz \pm 20%.
- "Peep-Peep" East-West audible signal (Electronic Bird Chirp) by method electronic varying frequency tone; Period 1.0 seconds \pm 20%; Duration of 0.2 seconds \pm 20%; Frequency base of 2,800 Hz \pm 20%; with frequency deviation - 800 Hz \pm 20%.
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____ 5.00 DETECTORS.

____ 5.01 VEHICLE DETECTORS.

5.01A INDUCTIVE LOOP DETECTORS.

The CONTRACTOR shall be responsible for locating the corners of each detector loop. The detector loop corners and home runs shall be marked by the CONTRACTOR and reviewed by the CITY INSPECTOR before the pavement is cut.

Unless noted otherwise on the plans, the stop bar loops for the through lanes shall be 6'X 35', type "C", and for left turn lanes shall be 6'X 50', type "C". All advanced and extension loops shall be 6'X 6', type "A".

The CONTRACTOR shall not start the installation of any detector loops if the threat of rain exists during the installation operation or during the next 24 hours.

The pavement slots shall be cut with an abrasive type saw. Residue resulting from the slot cutting operation shall not be permitted to flow across open traffic lanes. The minimum loop slot width shall be 0.250 inch and the minimum home run slot width shall be 0.375 inch. The minimum loop slot depth shall be 2.00" +/- 0.25". The minimum depth of the home run slot for the first three feet from the curb termination shall be 3.00" +/- 0.25". The depth of the home run slot shall be gradually reduced to 2.00" +/- 0.25" before the loop area is reached. All bends in the loop wire shall be greater than 90 degrees.

The CONTRACTOR shall install "Type 1" loop detector wire in the slots cut in the pavement only in the presence of the CITY INSPECTOR. At no time is the loop wire to be inserted in to the slot with a sharp edged tool (i.e. a screwdriver). The loop wire installed in the home run slot shall be twisted a minimum of two turns per foot prior to installation and twisted to the pull box.

After conductors are installed, paint binder shall be applied to all vertical surfaces of the slot in accordance with the provisions in STATE SPECIFICATIONS SECTION 39 - 4.02 "Prime Coat and Paint Binder". The CONTRACTOR shall then completely fill the slots with "OverKote Loop Filler," or approved equal. Excess filler shall be removed so that the finished level is flush with the pavement surface. The air temperature during installation shall be above 50 degrees F. and the temperature of the filler during installation shall be above 70 degrees F. The loop filler shall not be cut or diluted with water or solvent.

After conductors are installed the CONTRACTOR shall then completely fill the slots with hot-melt rubberized asphalt sealant.

Epoxy filler shall not be used except in concrete surfaces.

The loop detector wires shall be banded, in pairs, by lane and labeled with identification bands in the termination pullbox. Each label shall show the loop number, phase, and lane location. Identification bands shall be constructed from a nylon cable tie with 3/8" by 3/4" label flag attached (T&B Ty-Rap Cable Ties, #TY553 or approved equal). The marking pen shall be one recommended by the manufacturer of the cable tie and shall be an indelible marking pen capable of writing on the nylon material (T&B Marking Pen, #WT 163 M-1, Black or approved equal). No other method of labeling will be acceptable.

The loop detector lead-in cable shall be Type "B". Each loop detector lead-in cable shall be labeled in the termination pull box and in the controller cabinet. Each label shall show the phase and loop number. The drain wire in the detector lead-in cables shall be connected to the chassis ground by using a No. 14 (green) conductor wire and "PT" connectors.

The CONTRACTOR shall notify the ENGINEER when all loops and detector lead-in cable have been installed. The CITY shall test all loops and detector lead-in cables for conductor resistance, insulation resistance and loop inductance as specified in section ____ - 2.06 "Wiring", and make all necessary field splices. Once completed, the CONTRACTOR shall protect these installations from damage.

Asphalt concrete shall be used to fill all curb termination points.

____ 5.01A(1) SENSOR UNIT CONSTRUCTION.

The CONTRACTOR shall provide "card" type sensor units as provided in STATE SPECIFICATIONS SECTION 86-501A(3) and these Special Provisions. The sensor units shall:

1. Have a loop inductance range of 20 - 2500(uH).
2. Have four (4) available loop frequencies.
3. Have eight (8) available loop sensitivity levels.
4. Have a single enable/disable switch.

Sensor units shall function without "locking up". Any sensor units that "lock up" or fails to detect a vehicle when tuned shall be replaced with a new sensor unit.

____ 5.01B PREFORMED INDUCTIVE LOOP DETECTORS.

Type "A" (6'X 6') preformed inductive loops shall consist of four (4) turns of #16 AWG wire with a Type TFFN insulation encased in a 3/8 inch polypropylene conduit. Type "C" (6'X 35' or 6'X 50') preformed inductive loops shall consist of two (2) turns of #16 AWG wire with a type TFFN insulation encased in a 3/8 inch polypropylene conduit. The conduit shall be injected with hot rubber asphalt sealant to prevent the entrance of water and the movement of the wires within the conduit. The conduit shall contain sealed expansion joints.

The "Home-run" loop wire from the preformed loop to the termination pull box or detector hand hole shall be twisted together into a pair (at least two turns per foot) and encased in a polypropylene conduit injected with hot rubber asphalt sealant to prevent the entrance of water.

The preformed inductive loops shall be manufactured by "NEVER-FAIL" loop system or approved equal. The CONTRACTOR shall adhere to the manufacturer's specifications for Model "A" for installation in new AC pavement and Model "C" for installation in new PCC concrete pavement. The Model "A" frame shall be placed on top of the base

rock or next to the next-to-last AC pavement layer and paved over with a minimum of 2-1/2" of hot mix asphalt concrete pavement.

The CONTRACTOR shall notify the CITY INSPECTOR when all preformed loops and their detector lead-in cable have been installed. The CITY shall test all preformed loops and detector lead-in cables for conductor resistance, insulation resistance and loop inductance as specified in section ____ - 2.06 "Wiring", and make all necessary field splices. Once completed, the CONTRACTOR shall protect these loop installations from damage.

___ 5.01B VIDEO IMAGE DETECTION SYSTEM

Work under this item shall consist of furnishing and installing Video Image Detection System (VIDS) equipment at each site as described herein and as shown on the Plans. Communications equipment necessary to support video transmission and control signals between central and field equipment is described herein.

The Autoscope Video Image Detection System from Econolite Control Products will be used. Vendor contact information is:

Econolite Control Products, Inc.
1933 Davis Street, Suite 22
San Leandro, CC 94577
(510) 562-3215

Each VIDS field assembly shall consist of the following components:

Video Image Processor
Isolation Panel
Cables
In-cabinet LED video display for detector programming.

The Contractor shall furnish all materials necessary to provide a complete and functional VIDS system in accordance with this section of these Special Provisions. Miscellaneous equipment, and materials not mentioned but necessary to provide a complete and fully operational camera assembly shall be furnished by the Contractor as incidental to the work.

This specification sets forth the minimum requirements for a system that monitors vehicles on a roadway via processing of video images. The detection of vehicles passing through the field-of-view of an image sensor shall be made available to a large variety of end user applications as simple contact closure outputs that reflect the current real-time detector or alarm states (on/off) or as summary traffic statistics that are reported locally or remotely. The contact closure outputs shall be provided to a traffic signal controller and comply with the National Electrical Manufacturers Association (NEMA) type C or D detector rack or 170 input file rack standards.

The system architecture shall fully support Ethernet networking of system components through a variety of industry standard and commercially available infrastructures that are

used in the traffic industry. The data communications shall support direct connect, [modem,] and multi-drop interconnects. Simple, standard Ethernet wiring shall be supported to minimize overall system cost and improve reliability, utilizing existing infrastructure and ease of system installation and maintenance. Both streaming video and data communications shall optionally be interconnected over long distances through fiber optic, microwave, or other commonly used digital communications transport configurations.

On the software application side of the network, the system shall be integrated through a client-server relationship. A communications server application shall provide the data communications interface between as few as one to as many as hundreds of Machine Vision Processor (MVP) sensors and a number of client applications. The client applications shall either be hosted on the same PC as the communications server or may be distributed over a local area network of PC's using the industry standard TCP/IP network protocol. Multiple client applications shall execute simultaneously on the same host or multiple hosts, depending on the network configuration. Additionally, a web-browser interface shall allow use of industry standard Internet web browsers to connect to MVP sensors for setup, maintenance, and playing digital streaming video.

System Hardware

The machine vision system hardware shall consist of four components: 1) a color, 22x zoom, MVP sensor; 2) a modular cabinet interface unit; 3) a communication interface panel; 4) a 9" (minimum) color, flat-panel, in-cabinet LCD monitor with all associated accessories, mounting hardware, cable, cable connections, including USB mouse needed for instant detection-zone programming from within the cabinet. Additionally, the system shall be capable of connecting a personal computer (PC) to host the server and client applications that are used to program and monitor the system components. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The MVP sensor shall be capable of storing cumulative traffic statistics internally in non-volatile memory for later retrieval and analysis.

The MVP shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The MVP shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug in devices or converters required. The MVP shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary from 5 to 30 frames/sec as a function of video quality and available bandwidth.

The modular cabinet interface unit shall communicate directly with up to eight (8) MVP sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs or a 170 input file rack providing up to sixteen (16) contact closure inputs and twenty-four (24) contact closure outputs to a traffic signal controller. The communication interface panel shall provide four (4) sets of three (3) electrical terminations for three-wire power cables for up to eight (8) MVP sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to

electrically protect the modular cabinet interface unit and connected MVP sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP sensors. All required video detection system cables shall be either provided by the manufacturer, or certified as compatible with the system by the manufacturer through a Certificate of Compliance to be included with the project submittals.

System Software

The MVP sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard internet browsers to connect and perform basic configuration, maintenance, and video streaming services.

There shall be a suite of client applications that reside on the host client / server PC. The applications shall execute under Microsoft Windows XP or Vista. Available client applications shall include:

Master network browser: Learn a network of connected modular cabinet interface units and MVP sensors, display basic information, and launch applications software to perform operations within that system of sensors.

Configuration setup: Create and modify detector configurations to be executed on the MVP sensor and the modular cabinet interface unit.

Operation log: Retrieve, display, and save field hardware run-time operation logs of special events that have occurred.

Software install: Reconfigure one or more MVP sensors with a newer release of embedded system software.

Streaming video player: Play and record streaming video with flashing detector overlay.

Data retrieval: Fetch once or poll for traffic data and alarms and store on PC storage media.

Communications server: Provide fault-tolerant, real-time TCP/IP communications to / from all devices and client applications with full logging capability for systems integration.

MVP Sensor

The MVP sensor shall be an integrated imaging color CCD array with zoom lens optics, high-speed, dualcore image processing hardware bundled into a sealed enclosure. The CCD array shall be directly controlled by the dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance. It shall be possible to zoom the lens as required for setup and operation. It shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay. The MVP shall provide direct real-time iris and shutter speed control. The MVP image sensor shall be equipped with an integrated 22x zoom lens that can be changed using either configuration computer software. The digital streaming video output and all data communications shall be transmitted over the three-wire power cable supplied or approved by manufacturer.

Power

The MVP sensor shall operate on 110/220 VAC, 50/60Hz at a maximum of 25 watts. The camera and processor electronics shall consume a maximum of 10 watts and the remaining 15 watts shall support an enclosure heater.

Detection Zone Programming

Placement of detection zones shall be by means of a 9" (minimum) flat-panel LCD color monitor and mouse configured for use for instant detection zone programming from within the cabinet, or attached to the PC with a Windows XP or Vista operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.

The detection zones shall be created by using a mouse to draw detection zones on the PC monitor. Using the mouse and keyboard it shall be possible to place, size, and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the PC to the MVP sensor and cabinet interface module, to retrieve the detector configuration that is currently running in the MVP sensor, and to back up detector configurations by saving them to the PC fixed disks or other removable storage media.

The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the MVP sensor for different traffic applications or changes in installation site geometry or traffic rerouting.

Optimal Detection

The video detection system shall optimally detect vehicle passage and presence when the MVP sensor is mounted 30 feet (10 m) or higher above the roadway, when the image sensor is adjacent to the desired coverage area, and when the distance to the farthest detection zone locations are not greater than ten (10) times the mounting height of the MVP. The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required.

Although optimal detection may be obtained when the MVP is mounted directly above the traveled lanes, the MVP shall not be required to be directly over the roadway. The MVP shall be able to view either approaching or receding traffic or both in the same field of view. The preferred MVP sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear. The MVP sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to simultaneously monitor a maximum of six (6) traffic lanes when mounted at the road-side or up to eight (8) traffic lanes when mounted in the center with four lanes on each side.

Modular Cabinet Interface Unit

The modular cabinet interface unit shall provide the hardware and software means for up to eight (8) MVP sensors to communicate real-time detection states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of the detector rack standards. The card shall have 1500 Vrms isolation between rack logic ground and street wiring.

The modular cabinet interface unit shall be a simple interface card that plugs directly into a 170 input file rack or a NEMA type C or D detector rack. The modular cabinet interface unit shall occupy only 2 slots of the detector rack. The modular cabinet interface unit shall accept up to sixteen (16) phase inputs and shall provide up to twenty-four (24) detector outputs.

Communications Interface Panel

The communications interface panel shall support up to eight MVPs. The communications interface panel shall accept 110/220 VAC, 50/60 Hz power and provide predefined wire termination blocks for MVP power connections, a Broadband-over-Power-Line (BPL) transceiver to support up to 10MB/s interdevice communications, electrical surge protectors to isolate the modular cabinet interface unit and MVP sensors, and an interface connector to cable directly to the modular cabinet interface unit.

The interface panel shall provide power for up to eight (8) MVP sensors, taking local line voltage 110/220 VAC, 50/60 Hz and producing 110/220 VAC, 50/60 Hz, at about 30 watts to each MVP sensor. Two ½- amp SLO-BLO fuses shall protect the communications interface panel.

System Installation & Training

The supplier of the video detection system shall supervise the installation and testing of the video detection system and computer equipment. A factory certified representative from the supplier shall be on-site during installation.

A four hour session of training shall be provided to personnel of the contracting agency in the operation, setup and maintenance of the video detection system. Instruction and materials shall be provided for a maximum of 10 persons and shall be conducted at a location selected by the contracting agency. The MVP sensor and its support hardware/software is a sophisticated leading-edge technology system. Proper instruction from certified instruction is required to ensure that the end-user has complete competency in system operation. The User's Guide is not an adequate substitute for practical classroom training and formal certification by an approved agency.

Warranty, Service, & Support

For a minimum of two (2) years, the supplier shall warrant the video detection system. An option for additional year(s) warranty for up to 5 years shall be available. Ongoing software support by the supplier shall include software updates of the MVP sensor, modular cabinet interface unit, and supervisor computer applications. These updates shall be provided free of charge during the warranty period. The supplier shall maintain a program for technical support and software updates following expiration of the warranty

period. This program shall be available to the contracting agency in the form of a separate agreement for continuing support.

___ 5.02 PEDESTRIAN PUSH BUTTONS.

In an attempt to evidence compliance with the "American Disabilities Act" (ADA) the CONTRACTOR shall install/replace all new/existing pedestrian push buttons using Synchronex Pedestrian Push Buttons, part number 1ASY2021-40 "ADA-2", or approved equal. The pedestrian push button shall be tamper proof, shock proof in any weather condition, and suitable for the physically challenged.

The pedestrian push button housing shall be made of machined or die-cast aluminum. The housing shall be black, matching color 17038, 27038, or 37038 of Federal Standard No. 595b. The conical actuator shall be made of stainless steel or aluminum and extend 7/16" to 1/2" above the bezel of the housing and shall be 2" in diameter.

The pedestrian push button shall contain two (2) switches. The switches shall be a precision snap-acting type, single pole, single throw unit, with pressure type terminals, rated at 120 VAC, and 1 X 10⁴ operations. They shall be UL listed, CSA certified, and meet the requirements of NEMA ICS-1 and ICS-2.

The pedestrian push button shall have an operating force of 9 to 13 ounces and a minimum release force of 4 ounces. Pre-travel shall be 1/64 inch maximum. Over-travel shall be 7/32 inch minimum. Differential travel shall be 0.0004 to 0.002 inch.

The pedestrian push button assembly shall have recessed holes and be mounted within standard pedestrian push button housing with stainless steel, non-corrosive, tamperproof, fastening devices.

The CONTRACTOR shall finish to the CITY one (1) tool used to install and remove the tamperproof fastening devices.

___ 6.00 SAFETY LIGHTING.

___ 6.01 HIGH PRESSURE SODIUM LUMINARIES.

All luminaires shall be 250 WATT, 120/240 VOLT cutoff type, without glare shields. Receptacle for Photoelectric unit (PEU) shall not be provided.

___ 6.02 INTERNALLY ILLUMINATED STREET NAME SIGNS.

All internally illuminated street name signs shall be Type A, with double faced messages and City logo clearly legible under any lighting conditions. The sign shall consist of an extruded aluminum top, bottom, and door, cast aluminum ends, sign faces, and illumination.

The 0.125 inch extruded aluminum door shall open from the top, have a continuous stainless steel hinge on the bottom, be held close by three (3) 1/4 turn airlock fasteners, and sealed with a water tight PVC gasket. The door shall have one side removable to gain access to the sign face. The sign face shall be constructed of a single piece of white 0.125-inch polycarbonate plastic covered with a single piece of green translucent vinyl with the legend letters removed.

The top and bottom shall be extruded from 6063-T5 aluminum alloy. The top shall have a thickness of 0.140 inches and the bottom shall have a thickness of 0.094 inches. The ends shall be cast from 356 aluminum and have a minimum thickness of 0.188 inches. The top shall be constructed with a drip rail overhanging the sign face to help prevent water intrusion. The seams connecting the top and bottom to the ends shall be heli-arc welded to provide a weatherproof seal. Drainage shall be provided by drain holes located in the corners of the housing bottom.

The back plate and socket tracks shall be constructed from 0.063-inch aluminum. The reflectors shall be constructed from 0.020-inch aluminum. The interior of the sign and all interior parts shall be painted white.

Two (2) T12-CW-HO type 800 MA lamps shall provide fluorescent lighting. The ballast shall be a high output ballast (Valmont 6G3934WF or approved equal) and shall be mounted in the bottom of the sign assembly. All wiring shall be 600 volt, 90 degree C, #18 AGW soft annealed copper wire. The sockets shall be D-Die snap-in type sockets with a rubber gasket on the lamp-mating surface to prevent possible water damage.

The sign shall be mounted on the mast arm using PELCO No. SE-5015-I-I or ZAP SA-1000 mounting assembly or approved equal. The non-moving parts of the mounting assembly shall not be painted.

6.03 PHOTOELECTRIC CONTROLS.

The CONTRACTOR shall furnish and install a Type II photoelectric control (PEC) unit as shown on the plans. The PEC shall be connected to two (2) mercury displacement type contactors, installed in the Type III-AF Service cabinet.

One contactor shall be used for the safety lighting circuit and the other shall be used for the internally illuminated street name sign circuit.

7.00 WIRELESS INTERCONNECT SYSTEM

General Requirements

The wireless interconnect system shall consist of a YAGI antenna at each intersection, LMR-400 flexible cable connecting to the controller and a Spread Spectrum Wireless Modem by ENCOM. The YAGI antenna shall be mounted on the top of traffic signal pole, as indicated on the traffic signal plan, by using the method recommended by the manufacture.

Spread Spectrum Wireless Transceiver shall provide uninterrupted data communications within existing system. Each system will operate in a Point-to-Multipoint configuration

with one Master radio and up to 255 Remote / Repeater radios depending on the overall system layout.

The following shall be the minimum Spread Spectrum wireless modem requirements:

- Operate in the license- free, ISM Band (902-928MHz), utilizing Frequency Hopping Spread Spectrum Technology.
- Shall be ENCOM model 5171 or approved equal.
- Selectable Operating modes:
 - Master, Remote, Repeater, Remote/Repeater.
- Radio Receiver Sensitivity of -110dBm @ 10^{-6} BER.
- User Selectable Transmit Power:
 - 1mW to 1000mW (30dBm).
- Edge Connector Compatibility
 - Radio shall plug directly into a 170 controller modem slot.
 - Shall draw operating power from the controller card edge supply.
- Be compatible with the existing traffic signal controllers for both RS232 and 2 or 4 Wire FSK communications.
 - No additional internal or external modem required for 2 or 4 FSK communications.
- Baud Rate
 - 1200bps - 115.2Kbps (RS232).
 - 1200bps (Bell 202, 2 or 4 FSK).
- Have an operating temperature of -40C to +80C (-40 F to +176 F).
- An operating range of 20+ miles.
- Provide multiple repeater capabilities.
 - Single Radio Design with an active local COM port.
- All radios shall include comprehensive user-friendly software which features the following minimum diagnostics.
 - System-wide remote programming.
 - Radio timing drivers for all major traffic controllers.
 - Received signal strength indicator testing.
 - Built-in graphical spectrum analyzer.
 - Data polling-integrity testing.
 - Microsoft Windows® compatible.

___ 8.00 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT.

All existing traffic signal equipment to be reused as part of this project shall be removed, protected, and reinstalled as shown on the plans. All traffic signal equipment to be salvaged will be removed and delivered to:

CITY OF SAN RAMON
SERVICE CENTER
5000 CROW CANYON ROAD
SAN RAMON, CA 94583

___ **7.00 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT.**

All existing traffic signal equipment to be reused as part of this project shall be removed, protected, and reinstalled as shown on the plans. All traffic signal equipment to be salvaged will be removed and delivered to:

CITY OF SAN RAMON
SERVICE CENTER
5000 CROW CANYON ROAD
SAN RAMON, CA 94583

___ **8.00 PAYMENT.**

Full compensation for performing all the work as shown on the plans, as specified in the STANDARD SPECIFICATIONS and these special provisions, including furnishing all labor, materials, tools, equipment, and incidentals, and performing all alterations necessary to complete the work, shall be considered as included in the contract lump sum or unit prices paid for the various items of work, and no additional compensation will be allowed therefor.

Full compensation for locating and marking the corners of the detector loops, and locating and marking the positions of the signal standards and pull boxes, shall be considered as included in the contract price paid for the traffic signals, and no additional compensation will be allowed therefor.